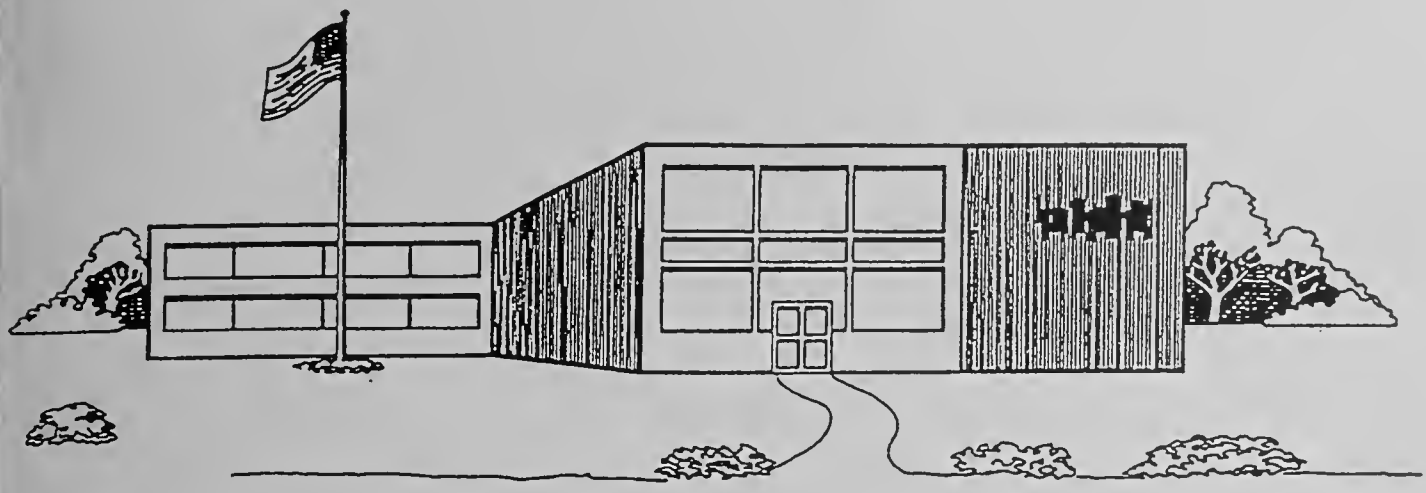
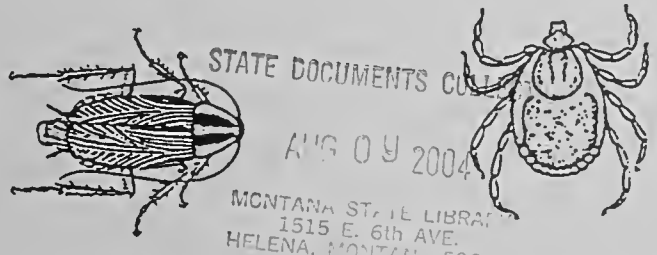
TEGRATED PEST MANAGEMENT IN MONTANA SCHOOLS TRAINING



A Study Manual for IPM in Montana School Pest Applicators



STATE OF MONTANA - DEPARTMENT OF AGRICULTURE
HELENA, MONTANA
JANUARY, 1996

Technical Document

Integrated Pest Management (IPM) in the School

In 1993, the Montana Legislature passed the Model School Integrated Pest and Pesticide Safety Program Act. This Act instructed the Montana Department of Agriculture to provide guidance and recommendations to school districts on the management of pests and pesticides and on alternative control methods in schools and on school grounds. The intent of the law is to encourage both reduced risk from and reduced use of pesticides in the school environment. A copy of the manual entitled, "The Montana Model School Integrated Pest and Pesticide Management Program," is available from the Montana Department of Agriculture.

This manual was prepared as a study guide for pest management personnel involved in controlling pests in Montana Schools under the School Pest Pesticide Applicator category. A discussion of Montana pests which are common in school situations is included. A companion computerized tutorial training program is also available from the Montana Department of Agriculture.

To simplify information, trade named products and equipment may be mentioned. No endorsement is intended, nor is criticism implied of similar products or equipment which are not mentioned.

We wish to acknowledge the help of personnel from the Agricultural Sciences Division, Montana Department of Agriculture, Montana State University College of Agriculture, the Montana State University Program of Agricultural Education, and the Cooperative Extension Service in preparing this manual.

Contents and materials contained in this manual have been prepared following the review of several publications. These publications are listed in the reference section of this manual.

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Chapter One

Integrated Pest Management (IPM) in the School

Public concern about health and environmental risks associated with pesticide use is increasing, particularly when children are involved. This has resulted in increased interest in the use of effective alternative pest control methods. School administrators and others with pest control decision making responsibilities for school buildings and grounds should become more aware of pest control options available to them. A copy of a model school pest program is available from the Montana Department of Agriculture (MDA).

The MDA, in cooperation with the Montana State University Program of Agricultural Education, prepared this document to acquaint people with **Integrated Pest Management** (IPM), which is an alternative approach to traditional pest control. Research has shown that IPM can reduce the use of pesticides and often provides more economical and effective pest suppression.

This manual and a companion computerized tutorial have been prepared to help in training school officials and school personnel to examine and improve their pest management practices. The content of the manual reviews the structure of an IPM program for all pests found in and around the school; identifies ways to reduce dependence on chemical control on school property; and discusses alternative methods that may be used to manage many of the more common pests.

Integrated Pest Management

IPM focuses on the cause of pest problems. Conventional pest control attempts to get rid of pests after they become a problem. If nothing is done to change the cause of the problem, pest problems will be endless. By changing the conditions that cause a problem, it is often possible to eliminate or reduce a pest's presence. Pest management can become easier over time, and many of the pest control practices that are already being done in the school will fit well with an IPM approach.

Integrated pest management, or IPM, is a pest management strategy that focuses on long-term prevention or suppression of pest problems with minimum impact on human health, the environment, and non-target organisms. IPM is a pest population management system that anticipates and prevents pests from causing damage. IPM can reduce pesticide applications and associated risks and costs by applying preventative pest management strategies before pests become a problem.

Implementing an IPM program requires an understanding of pests, their life cycles, environmental requirements, and factors that control them naturally. The underlying principle is to disrupt the life support system of the pest. Managers should have a knowledge of all control options for the pest and understand the need for a well-established, regular, systematic program for surveying pests and pest damage, assessing potential problems, monitoring current pro-

grams, and evaluating their success. An IPM program should be a plan that can be updated as changes in pest problems occur.

Components of IPM

In order to develop an IPM program that anticipates and prevents pests from causing damage, those responsible should understand the basic components of the IPM approach. Material presented in this manual will help school personnel understand the following components of an IPM program.

1. Develop the ability to identify the pest(s) in question. Different pests have different life cycles and live in different environments which determine appropriate control measures.

2. Monitor the pest population to help determine an appropriate level of pest tolerance. A few pests may not justify an extensive control program.

3. Use natural pest enemies whenever possible and practical to help control pests without the use of pesticides.

4. Control pests by making cultural and structural changes in the school facilities. Removing the source of food and shelter for pests is part of any well-planned IPM program.

5. Use pesticides in a judicious manner. Use the least toxic pesticides to help reduce dependence on chemical control of pests. Because children are more vulnerable to pesticides, it is important to minimize exposure of school children to pesticides.

Approach to an IPM Program

It is important to use common sense when developing an IPM program. Such an approach requires that applicators understand how to:

1. Identify the pest, describe its life cycles and determine how it interacts with the environment

2. Use a combination of pest control methods

3. Manage pest damage by the most economical means

4. Control pests with the least possible hazard to people, property and the environment

5. Judiciously use pesticides, and

6. Understand survival needs of pests in order to create an inhospitable environment for a specific pest. Creating such an environment will require the removal of the basic elements pests need.

Chapter Two

Planning an IPM Program

Integrated Pest Management (IPM) is an effective and environmentally sensitive approach to pest management that relies on a combination of common sense practices. IPM programs use current, comprehensive information on the life cycles of pests and their interactions with the environment. This information, in combination with available pest control methods, can be used to manage pest damage by the most economical means, and with the least possible hazard to people, property and the environment. IPM programs take advantage of all pest management options possible, including the judicious use of pesticides.

Understanding pest survival needs is essential to implementing IPM effectively. Pests seek habitats that provide basic needs such as air, moisture, food and shelter. Pest populations both indoors and outdoors can be prevented or controlled by creating an inhospitable environment for the pest. Remember, when developing a IPM program for the school, there are control methods other than pesticides. It is important that the basic elements pests need to survive be removed.

IPM Planning Strategies

An effective IPM program can be integrated into a school's existing pest management plan and other school management activities. Preventative maintenance, janitorial practices, landscaping, occupant education and staff training are all part of a school IPM program. There are a number of basic steps that can be taken in developing an IPM decision-making network within the school.

Early in the planning process, develop an official policy statement. Such a policy helps in making the transition from a conventional pesticide program to an IPM program. This statement should go beyond simply stating a commitment to support and implement an IPM approach. The statement serves as a guide for pest managers when developing a more specific IPM program.

It is critical that the various pest management roles for school occupants, pest management personnel and key decision makers be communicated. Educating and training people for their respective roles is essential to the establishment of a smooth-running IPM program.

Establish pest management objectives for a particular school site. Most likely, pest management objectives for each site will differ. The type of pest management program and the guidelines that will be followed in a specific facility should be carefully outlined.

In a workable IPM program, you must identify and monitor pest populations for potential problems before they occur. A careful inspection of the various sites will enable those responsible for pest control to determine when, where and how to approach the problem.

An action threshold is the population level at which action is initiated for each pest. The presence of some pests from a particular species does not necessarily require application of pesticides. However, a pre-determined action threshold will indicate the level of a pest population in certain site environmental conditions that

will require remedial action.

The IPM control strategies used on any given site in and around the school are dependent on the conditions that exist at a given location. These strategies might include redesigning and repairing structures, improving sanitation, or using traps. Keep in mind that a good IPM program means that all pesticides are applied judiciously.

Finally, devise a plan to evaluate the results of the IPM program to determine if pest management objectives are being reached. To do this, keep written records on all aspects of the program.

The Cost of an IPM Program

Whether an IPM program raises or lowers costs depends, in part, on the nature of the current housekeeping, maintenance and pest management operations. In many cases, costs are higher initially but reduced thereafter. The costs of implementing an IPM program may depend on whether the pest management services are contracted, performed in-house, or both. To fit the IPM program into the existing budgetary framework, school administrators must consider additional and redistributed expenditures. As with any program, insufficient resources will jeopardize the success of IPM in the school.

There are a number of potential added costs associated with IPM. The IPM program may require repair and maintenance activities to prevent pest entry and to eliminate sources of shelter, food and moisture. These are some examples of one-time expenses that may pay back with future budgetary savings:

1. Improved waste management: Move trash or garbage containers away from school buildings to reduce the opportunity for pest invasion. This cost is a onetime expense that will result in fewer pest problems and reduce the need for other pest control procedures.
2. Installment physical barriers such as air curtains over the outside entrances of kitchens. This will reduce flying insect problems. However, these devices do require maintenance to operate properly and these long-term costs need to be considered.
3. Increased structural maintenance to correct such situations as leaky pipes. This will reduce future maintenance problems and prevent some pest problems, saving money in the long-term.
4. Staff training in IPM. The amount of information necessary to implement IPM is greater than that required for conventional pest control. Consequently, training staff in IPM will likely result in increased costs.
5. Re-landscaping the area next to school buildings to discourage pests.

In the long run, these repair and maintenance activities will reduce overall costs of the pest control operation, as well as other maintenance and operating budgets. Whether these costs are actually budgeted as a pest control expense or under some other budget category depends on the budgeting system within the school. School systems with an active maintenance and repair program may be able to absorb the costs of these activities within the current budget.

Procurement

Successful practices of IPM rely on accurate record keeping and efficient procurement. As the IPM program progresses, pest control needs will be identified. Close consultation with a pest management specialist is essential for making sound budget decisions.

Some non-pesticidal products, such as traps, can be stocked to reduce purchases in future years, but few savings can be realized by purchasing pesticides in bulk. It is probably best to keep no more than a 60-day pesticide inventory to avoid long-term storage problems. Buy only what is needed for the current season.

In-House or Contracted Services

IPM programs can be successfully implemented by "in-house" school employees or by contracting with a pest control company. A combination of "in-house" and contracted services may be mixed and matched to the needs and capabilities of the school system. Both approaches have advantages and disadvantages, and individual school systems must decide what is best for them. Anyone applying pesticides in the school environment, contracted or "in-house," must be properly licensed through the Montana Department of Agriculture.

Chapter Three

Safe Use of Pesticides in an IPM Program

Chemicals are a part of our daily lives. Modern life as we know it would be impossible without chemicals. Plastics, drugs and cleaning products are just a few of the things that are made from chemicals. But they must be treated with respect. Chemicals can cause injury or illness if not handled properly.

The uncontrolled use of chemicals in and around the school can cause serious problems. Some people are sensitive to chemicals. Reducing the amount of chemicals used in a school setting will help reduce liability while increasing public safety at the same time.

What Are Pesticides?

Pesticides are chemical substances that are used to manage pests by killing them or disrupting their normal growth, behavior and development. Pesticides may either kill, repel, attract, or otherwise alter a pest's life processes. In a school IPM program, pesticides are used to prevent pests from causing damage, becoming a nuisance, or posing a health problem to students and staff.

Most pesticides have names that end in "cide," which means "to kill." Therefore, herbicides affect plants, insecticides control insects, fungicides are used against fungi and rodenticides kill rodents. The term pesticide is an umbrella term to include all of these chemical substances and substances such as disinfectants.

Pesticides are toxic substances that have been developed for a purpose. When used as directed, they seldom cause a significant problem. When problems do occur they are usually correctable. There is no way to generalize about pesticides. Each one must be used within the environment for which it was designed. One cannot conclude that a problem with one pesticide will result in a similar problem with another pesticide. Common sense judgement and action based on the best scientific evidence should prevail at all times.

How Pesticides Work

Regardless of the pest, the life processes of the organism depend on a very complex series of chemical reactions and interactions. When these reactions and interactions are disrupted, the pest is seriously affected. Insect and vertebrate pests may be affected through actions on tissues that are a part of the nervous, respiratory, circulatory, digestive, or reproductive system. In the case of plants, pesticides may desiccate, inhibit photosynthesis, disrupt cell division, or prevent the production of essential cellular components.

Toxicity

When referring to pesticides, toxicity is the innate capacity of the chemical to be poisonous. When a pest is affected rapidly by a pesticide, the condition is referred to as **acute toxicity**. This condition may result from a single dose or a series of closely spaced exposures. Toxicity is dose-related. On the other hand, **chronic toxicity** results from prolonged or repeated low-level exposure to a poisonous substance. The effect of

chronic toxicity may be temporary, and the results of chronic exposure may not be evident for some time.

Acute toxicity is measured and recorded using a system referred to as LD50* (LD = Lethal Dose). The term represents the dosage needed to kill 50% of a population of test animals such as rats or mice. Toxicity is expressed in milligrams of a compound per kilogram of body weight; i.e., ppm. An LD50 of 6 mg/kg means that 6 milligrams of a certain substance per kilograms of test animal will be needed to kill 50% of the test population. The smaller the LD50, the more toxic the pesticide (See Table 1.).

identified by the signal word "WARNING." A lethal dose is approximately a teaspoon to a tablespoon of a pesticide (e.g., Diazinon). A Category III pesticide is identified by the signal word "CAUTION." A lethal dose is one tablespoon to a pint (e.g., Tordon). A Category IV pesticide has no signal word and is relatively non-toxic unless consumed in copious amounts (e.g., household cleaners).

Hazard

The degree of danger involved in using a pesticide is referred to as hazard. Hazard varies

Table 1. Toxicity Categories for Labeling Pesticides

Category	Signal Word Label	LD50 for 150-lb. human		Oral LD50 in Common Measuring Units
		Oral LD50 (mg/kg)	Dermal LD50 (mg/kg)	
I	Danger	0-50	0-200	Taste-teaspoon
II	Warning	50-500	200-2000	Tsp-tablespoon
III	Caution	500-5000	2000-20,000	1 oz.-pint
IV	None	Over 5,000	Over 20,000	Over a pint

** LD50 is the amount of pesticide, measured in milligrams per kilogram of body weight, that will kill one half of the exposed population.*

Pesticides are classified into four broad categories of toxicity. Specific signal words found on the pesticide label give an indication of the toxicity of that product to humans. A Category I product is identified by the signal word "DANGER." These pesticides may cause toxic effects on contact with the skin or may be extremely corrosive to skin and eyes. As Table 1 indicates, Category I pesticides are the most toxic if swallowed. It takes just a taste to a teaspoonful of some Category I products (e.g., Parathion) to be lethal. A Category II pesticide is

according to the amount and length of exposure to a pesticide. A compound with a high toxicity, acute or chronic, can be used with little risk if exposure to it can be eliminated. The more exposure, the higher the risk. Preventing exposure is the key to the safe use of any pesticide. Remember, hazard = exposure x toxicity. The complete information on the toxicity of the pesticide may be found in the MSDS (Material Safety Data Sheets) which are available through a local dealer or the company manufacturing a pesticide.

Pesticide Labels

Every pesticide container has a label. It is required reading. It is not just fine print on a piece of paper—**it is a legal document.** It provides directions needed for mixing and application and other pesticide product information. More importantly, it tells how to use the pesticide safely. The directions given on the label are designed to ensure the safe and effective use of pesticides, and failure to comply can harm humans, animals and the environment, as well as lead to possible legal liability.

Warning or caution statements tell how to avoid the hazards the product poses. Within the precautionary statement or elsewhere on the label, emergency first aid measures must be stated. The label must also state what types of exposure require medical attention.

Precautionary statements tell in what ways the product may be poisonous. It will also tell how to avoid poisoning, such as using protective clothing or ventilation requirements. If the pesticide is highly toxic, this section must inform physicians of the proper treatment for poisoning.

The **physical and chemical hazards** section will note if the pesticide may pose any fire, explosion, or chemical hazards.

Environmental hazards. If used improperly, pesticides or pesticide residues may contaminate water supplies, accumulate to dangerous levels in the environment, or harm birds, fish, or wildlife. To avoid these problems, the label will contain environmental precautions that may apply to air, water, soil or wildlife.

An **endangered species** statement tells if the pesticide has potential for harming an endangered species or its habitat. If so, restriction statements will appear which indicate where the pesticide may not be used.

Directions for use are instructions on how to use the product properly within its legal requirements to get the best results. The directions will tell you:

1. The pests the product is registered to control.
2. The sites, crops, animals, or other items the product can be used on. It is illegal to use a pesticide on a site not listed on the label.
3. How to apply the product.
4. How much pesticide to use.
5. Where it should be applied.
6. How frequently it should be applied.
7. How soon a crop may be used or eaten after the product is applied.

Reentry statements tell how much time must pass before people can reenter a treated area without appropriate protective clothing and equipment. If no reentry statement appears, then all unprotected workers must wait until sprays have dried or dusts have settled before reentering. If a reentry period is in effect and early reentry is required, the protective clothing to be worn will be described.

All pesticides must be registered with the EPA and have EPA **registration and establishment numbers on their labels.** The registration number is often written on the front panel of the label and is written as "EPA Registration No. XXX." The establishment number, a code of the factory that made the chemical, must also be on every pesticide container. It usually appears under the registration number.

A pesticide may be available in more than one **type of formulation**: liquids, wettable powders, emulsifiable concentrates, dusts and others. Different types of formulations require different methods of handling. The label will describe the type of formulation the package contains and how to use it properly.

Chemical companies are required by law to conduct extensive testing on a product and include a **misuse statement** before placing it on the market. They must meet all labeling requirements and prove that labeling information is correct. To use a pesticide product in any manner inconsistent with its labeling is a violation of federal law. The misuse statement reminds users of this fact.

Every pesticide container must carry a **child hazard warning** statement "Keep Out Of Reach Of Children" on the front label.

Every pesticide label must have an **ingredient statement** for the product. It must show the percentage of active ingredient and the percentage that is inert. The name of the active ingredient must also be listed. It can be written by chemical name or by common and chemical name. The inert ingredients do not need to be identified.

There are two **names for the product** on the label. The brand name is the name, brand or trademark used in ads by the company that makes the product and is the most identifiable name for the product. Many times, a chemical with a complex scientific name is also given a simpler common name. The scientific and common names do not vary among companies. Brand names are different, depending on which company made the chemical.

The **name and address of the manufacturer** that produced or distributed the product must be on the label so the purchaser of the product knows who made or sold the product and can contact them if necessary.

The label must show the **net contents** of the product in the container. This can be expressed in ounces, liters, pounds, or other units.

Every pesticide product has a **use classification statement** established by the EPA as either restricted use or unclassified/general use. Every pesticide product classified as restricted use must carry the following statement in a prominent place at the top of the front panel of the pesticide label. **Restricted Use Pesticide: For retail sale to and use by only certified applicators or persons under their direct supervision and only for those uses covered by the certified applicator certificate.** Examples of restricted use pesticides include Tordon (picloram) and Zinc Phosphide.

Applying Pesticides Judiciously

Many pesticides are available for use against urban and structural pests. Before application, pest managers should consider the toxicity of the product and application techniques. Because excessive or improper application of pesticides can cause injury, these materials should be applied by qualified applicators in a manner to ensure maximum efficiency with minimal hazard.

Although the US EPA registers pesticides for use within the United States, registration should not be taken to mean that a particular pesticide is "safe" under all conditions of use. Read and follow the pesticide label directions, know how to apply and handle these chemicals and try to minimize exposure to people and non-target species of animals and plants.

The following general recommendations should be considered:

1. All pesticides used in Montana must be registered by the US EPA and the MDA.

2. Pesticide applicators must be licensed or certified by the Montana Department of Agriculture as well as read and follow all label instructions to apply pesticides in a school environment.

3. Choose a pesticide that is labeled for the specific site and intended for the pest you are trying to control. Use target-pest specific pesticides when possible rather than a broad spectrum pesticide.

4. Use spot treatment applications whenever possible.

5. Limit the use of sprays, foggers and volatile formulations. Instead, use baits and crack and crevice application when possible. Look for crack and crevice label instructions on how to apply the pesticide. These treatments maximize the exposure of the pest to the pesticide while minimizing the pesticide exposure for the occupants.

6. Place all rodenticides, regardless of packaging, either in locations not accessible to children and nontarget species or in tamper-resistant bait boxes. Outdoors, bait should be placed only in tamper-resistant bait stations to prevent nontarget animals from gaining access to the bait. Securely lock or fasten shut all bait box lids. Place bait in the baffle protected feeding chamber of the box and never in the runway of the box.

7. Apply pesticides when occupants are not present or in areas where they will not be exposed to the material applied. After application of aerosols or sprays, ventilate the room thoroughly as indicated on the pesticide label or as required by other regulations. Note any reentry time limits listed on the label and be aware that some residues can remain long after application.

8. Use proper protective clothing or equipment when applying pesticides. Properly ventilate areas after pesticide application.

9. As part of the school pest management policy, notify students, staff and parents of upcoming pesticide applications. Pay particular attention to individuals who may be sensitive or at higher risk.

10. Keep copies of current pesticide labels, consumer information sheets and Material Safety Data Sheets (MSDS) accessible.

Storing Pesticides

Proper storage of pesticides is especially critical in and around school facilities. Store pesticides off-site or in buildings that are locked and inaccessible to all unauthorized personnel and students. Be sure adequate ventilation is provided for the pesticide storage area. Avoid storing pesticides in places where flooding is possible or in open places where they might spill or leak into the environment. If possible, store in areas with concrete or other solid flooring and protect from heat and cold.

Store all pesticides in their original containers, with label intact, away from an ignition source and be sure to identify the area where pesticides are being stored. Carefully check state recommendations and requirements for pesticide storage.

If pesticides are stored in occupied buildings, special care is necessary to ensure the air does not become contaminated. Notice should be placed outside the designated storage area. All pesticides must be stored in their original containers and lids should be tightly secured. Make sure that childproof caps are properly fastened.

However, even closed pesticide containers may volatilize toxic chemicals into the air. Therefore, pesticides should only be stored in spaces that are physically separated and closed off from occupied spaces and where there is adequate exhaust ventilation (i.e., the air is exhausted directly to the outside). In addition, take care to ensure that the air in the storage space has no chance of mixing with the air in the central ventilation system.

A designated person should be responsible for periodically checking stored pesticide con-

tainers for leaks or other hazards. To reduce pesticide storage problems, buy only enough of the pesticide to last through the use season. Mix only the amount of pesticide that is needed for the immediate application.

Posting and Notification

Local law may require schools to notify students and staff of impending pesticide applications. The school system may take the responsibility to inform school staff and students' parents of upcoming pesticide treatments. When good IPM practices are followed, concerns raised by notification and posting activities will be minimized. If notification and posting is a new practice at the school, the new policy should be explained so it will not be misinterpreted to imply that more pesticides are being applied.

Advance notification can be accomplished by posting signs around the school, sending notices home with students, or by other practical methods. Schools should consider posting notices in areas to be treated or that have been treated. The person responsible should be prepared and available to provide more specific information to school administrators, concerned parents and others.

A voluntary registry of individuals who are adversely affected by exposure to pesticides should be kept at the school. Information on how to contact the local poison control center and emergency personnel should be kept accessible.

Transportation of Pesticides

A few simple rules should be followed when transporting pesticides. Pesticides should never be transported in a closed vehicle in which school children are present. Pesticides should, if at all possible, be transported in the back of an open pickup or truck. If, as a last resort, pesticides must be transported in a sedan, make certain they are placed in the trunk in such a manner to prevent spills.

Always transport pesticides in their original labeled container, making sure that the lid is on tight and does not leak. Glass containers should be packed to prevent breakage during transport. All pesticide containers should be stabilized so they will not roll or slide during transport. Upon arrival at the final destination, unload all pesticide containers immediately and place them in the appropriate storage facility.

In the event of an accident, remove all persons from possible exposure. Contain any spills and report spills to the appropriate authorities. Under certain conditions, failure to report pesticide spills can result in civil penalties.

Chapter Four
IPM and School Structures

School structures, due to their design, often create pest problems. Areas that exist between, over, under and in buildings tend to become pest habitats if they are not monitored, cleaned, maintained and used on a regular basis. Proper structural design and maintenance can eliminate many pest problems. Close all small holes and use barriers to keep many insects and vertebrate pests from becoming problems inside of structures. Proper construction of foundations, to include pest barriers, will help prevent pests that burrow or inhabit the soil from entering buildings.

Examples of pest habitats in structures are attics, crawl spaces, maintenance tunnels and small spaces between adjoining buildings that are hard to maintain, not frequently used and often forgotten about until a pest problem exists.

Structural maintenance and cleaning is of crucial importance in an IPM program. Structures that are allowed to fall into disrepair or not cleaned on a regular basis are prime candidates for pest infestation. Proper structural design, good maintenance and frequent cleaning are important factors in pest control.

Pest preventive measures can be incorporated into existing structures. Such preventive measures reduce the need for pesticide applications and include sanitation and structural repair, using physical and mechanical controls, such as screens, traps and air doors. Every school will experience slightly different combinations of pests. Therefore, specific IPM strategies for specific school sites will be needed.

IPM Strategies for Indoor Sites

Typical indoor pests include mice, rats, cockroaches, ants, flies, wasps, hornets, yellow jackets, spiders, microorganisms, termites, carpenter ants and other wood destroying insects. Although wasps, hornets, yellow jackets and spiders are beneficial as predators of some pests, stinging or biting arthropods can be troublesome or hazardous to students and staff.

Entryways:

Doorways, overhead doors, windows, holes in exterior walls, openings around pipes and electrical fixtures or ducts provide entryways for many of the common pests. The entry of these pests can be greatly reduced or eliminated by:

1. Keeping doors shut when not in use.
2. Placing weather stripping on doors and maintaining tight door thresholds.
3. Caulking and sealing openings in walls and utility chases.
4. Installing or repairing screens.
5. Installing air curtains.
6. Keeping vegetation, shrubs and wood mulch at least one foot away from all structures.

Classrooms and Offices:

Classrooms, laboratories, administrative offices, auditoriums, gymnasiums and hallways often provide hospitable conditions for pests. There are a number of conditions that can be

maintained to reduce pest populations in these areas:

1. Allow food and beverages only in designated areas.
2. If indoor plants are present, keep them healthy. Occasionally, indoor plants may be a source of pests. When small insect infestations appear, remove them manually. If mechanical removal is not possible, use insecticidal soaps or insecticides that are not volatile. It may be necessary to move the plants to an unoccupied room for treatment.
3. Keep areas as dry as possible by removing standing water and water damaged or wet materials.
4. In the science lab, store animal foods in tightly sealed containers and clean cages regularly. In all areas, remove dust and debris.
5. Clean lockers and desks routinely.
6. Vacuum carpeted areas frequently.
7. If students get head lice, consult your local health department and have their parents contact a physician. Discourage students from exchanging hats or caps.

Food Preparation and Serving Areas:

The dining room, main kitchen, teachers' lounge, home economics kitchen, snack area, vending machines and food storage rooms may provide suitable living conditions for many pests.

1. Store food and waste in containers that are inaccessible to pests. Containers must have tight lids and be made of plastic, glass, or metal. Waste should be removed at the end of each day.
2. Place screens on vents, windows and floor drains to prevent cockroaches and other pests from using unscreened ducts or vents as pathways.
3. Create inhospitable living conditions for pests by reducing the availability of food and water, removing food debris, sweeping up all crumbs, fixing dripping faucets and leaks and drying out wet areas.
4. Improve cleaning practices by promptly cleaning food preparation equipment after use and removing grease accumulation from vents, ovens and stoves. Use caulk or paint to seal cracks and crevices.
5. Capture rodents by using mechanical or glue traps. Place traps in areas inaccessible to children. Mechanical traps, including glue boards, used in rodent control must be checked daily. Dispose of killed or trapped rodents within 24 hours.

Rooms and Areas With Extensive Plumbing:

Bathrooms, rooms with sinks, locker rooms, kitchens, swimming pools and greenhouses provide ideal conditions for many pests.

1. Promptly repair leaks and correct other plumbing problems to deny pests access to water.
2. Routinely clean floor drains, strainers and grates. Seal pipe chases.
3. Keep these areas dry. Avoid conditions that allow formation of condensation. Areas that never dry out are conducive to molds and fungi. Increasing ventilation may be necessary.
4. Do not store paper products or cardboard boxes near moist areas, directly on the floor, or against the wall. This also permits easy inspection.

Maintenance Areas:

Boiler rooms, mechanical rooms, janitorial-housekeeping areas and pipe chases should be carefully maintained.

1. After use, promptly clean mops and mop buckets. Dry mop buckets and hang mops vertically on a rack above a floor drain.
2. Allow eating only in designated areas.
3. Clean trash cans regularly, use plastic liners and secure lids.

4. Keep areas as clean and as dry as possible and remove debris.

IPM Strategies For Outdoor Sites

Rodents, insects and other pests may enter school structures from the outdoors. Proper maintenance of building exteriors and sanitation of playgrounds, parking lots, athletic fields, loading docks and refuse dumpsters helps prevent outdoor pests from gaining access to school buildings.

1. Seal all holes, cracks, ducts, vents and other openings that provide entry for pests.
2. Regularly clean trash containers and gutters and remove all waste, especially food and paper debris.
3. Secure lids on trash containers.
4. Repair cracks in pavement and sidewalks.
5. Provide for adequate drainage away from the structure and on the grounds.

Inspection For Wood-Destroying Pests

Inspecting for wood destroying organisms is one of the more complex tasks in pest control. The person inspecting must be very thorough and methodical.

The inspector must be able to locate wood destroying insects and fungi and identify conditions which are conducive to these pests. Wood, particularly damp wood, that comes in contact with soil provides entry points. Termites occur only sporadically in Montana, but carpenter ants are commonly found, especially in wooded areas or heavily landscaped neighborhoods.

It is important to understand the pests' life cycle, be able to identify insects on sight and to understand necessary structural corrections. Local weather conditions will determine the types of wood destroying pests that may be found in and around the school buildings.

The following suggestions will aid in evaluating problems or locating potential problem areas. In some cases, it may be necessary to seek outside assistance in order to correct an existing condition to meet local building codes.

Exterior

1. Prepare a diagram of foundations, sheds and outbuildings that need to be inspected.
2. Look for drainage problems around the buildings.
   a) Don't let moisture accumulate adjacent to the foundations.
   b) Porches or patio attachments should slope away from the building.

3. Planters.
   a) All planters should be properly waterproofed.
   b) Make sure planters do not come in contact with the building.

4. Porch or patio structures.
   a) Sills and headers should not touch the soil.
   b) All wood members should be separated from the soil.
   c) Enclosed structures must be ventilated and accessible.

5. Outside wall covering.
   a) Wood siding should not come in contact with the soil.
   b) Shrubs or vines should not be allowed to grow against the siding.
   c) Brick veneer should have proper footings and weep holes.

6. Wood that is in contact with soil.
   a) Gate posts, fence posts, patio cover posts and wood decks must be treated, or insert concrete footings or metal sheeting.
   b) Wooden steps should not come in contact with the soil.

7. Wooden door jambs or porch rail supports should be embedded in concrete.

8. Crawl spaces.
   a) Vents should be installed to provide adequate ventilation.
   b) All vents should be screened.
   e) Vents should not be blocked by shrubs or debris.
   f) Window wells around crawl vents should not be below grade.
   g) There should be no rot, termite, or ant damage to the building frame.
   h) Inspect for mud tunnels constructed by certain termites to cross foundations from soil to walls or subflooring.

9. Eaves.
   a) Gutters should be functioning properly. They should not be leaning or clogged with debris. There should be no damaged downspouts, elbows, or splashblocks.
   b)There should be no water leaks or rot in the fascia, sheathing, or soffits.
   c) The ends of rafters should not show signs of rot or insect damage.
   d) Soffit vents should not be blocked with insulation.

10. Basement window frames should not be below grade.

11. There should be no rot on the siding.

12. Look for evidence of carpenter ants, including sawdust, around the perimeter.

Interior

1. Look for damage to floors caused by carpenter ants, termites, or fungi due to plumbing leaks.

2. There should be no wood decay in the lower window frames.

3. Stall showers.
   a) All loose tile should be reset and all gaps caulked.
   b) There should be no soft spots under floor coverings.
   c) Look for soft spots or water stains caused by water leaks.
   d) Look for water stains caused by roof leaks or leaking upstairs bathroom plumbing.

4. Other plumbing.
   a) Look to see if any toilet water supply pipes, fittings, or gaskets are leaking. Be sure there are no soft spots around toilets.
   b) Look for leaks under water heaters.
   c) Make certain there are no leaks in sink drains that are under cabinets.

Attic Area

Most newer school structures do not have attics. If there is an older building on the school site with an attic, the following guidelines may be helpful.

1. The attic should be accessible.
2. Chimneys and pipes passing through the roof need to be sealed.
3. The attic should be adequately ventilated and vent areas covered with screen.
4. Look for evidence of carpenter ants, termites, wasps, or bees.
5. Look for evidence of birds or bats nesting in the attic.

Proper Maintenance

The proper maintenance of school buildings is critical in preventing the infestations of wood destroying pests. Once the pests have established themselves in the structural frame of the building, they are much more difficult to control and/or eliminate without the use of toxic pesticides.

Essential Equipment for Structural Pest Control

Flashlight

A good flashlight is necessary when looking for structural pests. Proper lighting can make the difference between success and failure in locating a pest problem.

A flashlight delivering a bright, concentrated beam of light is best.

Rock Pick, Hammer, Awl, or Screwdriver

These tools may be used for sounding and probing wood. The rock pick is especially useful for sounding and probing structural wood in crawl spaces. Use the awl or screwdriver for exterior or interior finished surfaces that a rock pick will damage. Be careful not to scratch or mar finished surfaces while searching for unsound wood.

Hand-held Compressed Air Sprayer

The air sprayer can be useful for pesticide applications. Properly using and maintaining sprayers can simplify pest management. Use of gloves, eye protection and a respirator is recommended when mixing concentrated pesticides. This protective equipment is essential if you apply pesticides in an enclosed space. It is a good practice to use separate sprayers for insecticides and herbicides. Thorough cleaning between applications is important.

Hand Dusters

The hand duster is useful to apply small quantities of insecticide dust in thin layers into cracks and crevices, wall voids or equipment voids. A key rule for applying dusts is to remember that thin layers of dust are most effective. Some crawling insects are repelled by thick layers of dust. To achieve fine, thin layers of dust, use the "shake-squeeze-pull away" technique as follows:

1. Fill your duster no more than 2/3 full. This will allow for adequate air space to create an air-dust mixture inside the duster prior to squeezing the dust out.

2. Always keep the spout above the level of the dust inside the duster.

3. Squeeze the duster gently to ensure thin layers of dust. When dusting correctly, you should barely be able to see the dust emerging from the tip of the duster.

4. Shake the duster continually between each squeeze to create the air-dust mixture.

5. Before relaxing your squeeze on the duster, pull it away from the surface or crack to prevent sucking up lint, moisture, or debris. Small amounts of these items will eventually cause the dust to lump and result in clogging of the duster.

6. Place pebbles or small ball bearings in the hand duster to aid in agitation and breaking up clumps of dust.

7. When storing, place hand dusters in tight, dry containers or zip lock bags. Each duster should be labeled properly as to its contents.

8. Do not place the tip of the duster in a moist spot or allow the duster to sit in moist environments because the duster will absorb water and then become clogged.

9. Do not use dusters which have been used for rodenticide tracking powders to apply insecticides unless the duster is thoroughly cleaned and all tracking powder removed.

Some pest control operators use a regular plunger-type duster. These have the advantage of having a somewhat larger capacity than the hand

dusters mentioned previously and can be used on larger size jobs without stopping to fill the dusters so often.

Small compression air tanks are available for applying dust and are useful for larger areas, such as wall voids. These tanks are similar to fire extinguishers.

Foggers

In this manual, canned aerosols will be referred to as foggers. Insect foggers are effective as space sprays against flying insects such as mosquitoes and flies but less effective against crawling insects. They can also be used to control wasps that construct paper nests. Better alternatives are the exclusion techniques discussed earlier for all pests, and crack and crevice treatments for crawling insects. Total release aerosols can be set and left in place to "fog" entire rooms or crawl spaces. This method will provide knockdown and kill of flying insects and can reduce numbers of crawling insects when used in initial treatments of heavy infestations.

The insecticides used in "foggers" contain quick knockdown agents such as pyrethrins, resmethrin and allethrin. Synergists such as piperonyl butoxide, sulfoxide and others may be combined with these pyrethroid insecticides to enhance their knockdown and killing abilities. Frequent retreatment is usually necessary. Care must be taken to limit exposure of building occupants.

Chapter Five
Pest Identification and Diagnosis

Accurate identification of a pest, whether it is an insect, a weed, a vertebrate, or a plant disease, is the key to carrying out an effective IPM program in a school setting. Good IPM practices are designed to take advantage of particular characteristics and growth habits displayed by these pests. Before embarking on a pest control program, it is important to identify the pest accurately.

Many common pests will be easily recognized based on past experience, but occasionally assistance will be needed. It may be necessary to consult the library for pest identification books and publications for the geographic area. The local Extension Service may be able to quickly confirm the identification of a particular pest.

In some cases, it may be necessary to contact a state Extension Service diagnostic laboratory. Laboratory personnel may be able to confirm an identification over the phone, but generally, they must directly inspect the specimen. If a specimen is required, the following procedures are recommended.

Insect sample preparation

Put the insect in a small, sturdy jar, with a few pieces of plant material. Live specimens are best, but if you are unable to collect live ones, put soft-bodied insects in alcohol or a dilution of one part water mixed with one part antifreeze. Do not mail insects attached to tape or in envelopes where postal equipment will smash them. Mail the specimen as soon as possible; it will begin to deteriorate rapidly. If the organism is an insect, send it to:

Insect Diagnostic Lab, Entomology Department
442 Leon Johnson Hall
Montana State University
Bozeman, MT 59717
(406) 994-5690

Plant disease sample preparation

If possible, send the entire plant. The symptoms might be visible in the leaves, but the actual problem could be in the roots, so the whole plant needs to be examined. Dig the plant, rather than pull it, and place the roots and attached soil in a plastic bag. Then place the entire plant in a paper bag to prevent drying. For branches or twigs, select those which are just beginning to show symptoms, wrap the cut ends in damp paper towels and place a plastic bag over the towels. Put the branch in a paper bag or wrap in newspaper. For lawn problems, take samples that are six inches square and three inches deep and place in a paper bag. If the organism is a disease, send it to:

Plant Disease Clinic, Dept. of Plant Pathology
Leon Johnson Hall, Room 525
Montana State University

Bozeman, MT 59717
(406) 994-5150

Weed specimen preparation

Place the plant in a plastic bag with damp (not wet) paper towels. Include the roots, cleaned of soil and debris. If the weeds are small, collect at least three. Keep the sacks in a cool place, away from sunlight. Also include collection date, state, county and geographic location where specimen was collected, elevation if known, date and any information that might be pertinent. Send it to:

Herbarium, Lewis Hall
Montana State University
Bozeman, MT 59717
(406) 994-4424

Quality of specimen

For accurate identification, the specimen must be in good condition when it is received at the diagnostic lab. Try not to crush the organisms, and pack them so they will not be crushed in the mail. Mail them no later than Thursday morning to prevent a stay in the post office over the weekend. If a specimen must be held at home over the weekend, keep it in a cool, dry place until you mail it.

Include the school name, address, phone number, location where the specimen was collected and any other information that might be pertinent. Specimen identification forms to help supply pertinent information can be obtained from each of the addresses above. It will save time to keep a supply on hand.

Keeping a record

When a sample specimen is sent for identification, it is suggested that another be kept for future reference, because samples are not usually returned. Keep duplicate records of potentially important information, including current and previous conditions, management routines, pest control activities, etc. Useful information can include:

1. Date the specimen was collected.

2. Address where the specimen was collected.

3. Specific area where the specimen was collected (e.g., "north side of gym," under gutter. etc.).

4. Maintenance practices that might have a bearing on the situation.

5. Previous pest control efforts.

6. Host plant, if the pest was found on a plant.

7. Weather, current and in previous weeks.

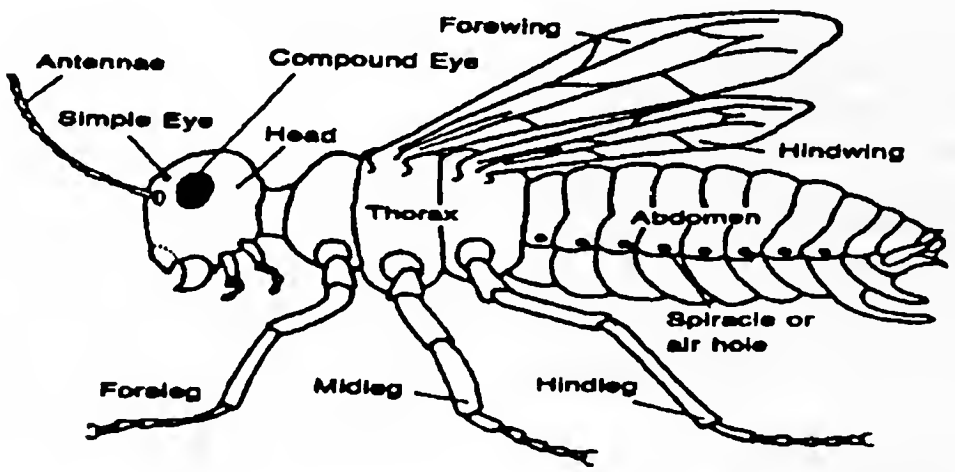
Chapter Six
Insect and Insect-like Pests

Insects are a very large and diverse group of animals. However, less than 1% of insect species are pests. Most insects are beneficial or harmless. When an insect starts to cause plant loss, transmit disease, cause structural damage, or disrupt the learning process, it becomes a pest and must be dealt with.

It is important to be able to distinguish one group from another. If the insect is a pest, learn the identity, damage, habitat and life cycle. The success of an IPM program may depend on this background knowledge.

It is important to know a little about anatomy in order to use identification manuals. Several key characteristics of insects are:

- **an exoskeleton which is a supporting structure composed of chitin on the outside of the body,**
- **a segmented body broken into three regions, head, thorax and abdomen (Fig. 1),**
- **adult insects have three pair of legs,**
- **adults have compound eyes and segmented antennae, and,**
- **external mouth parts.**



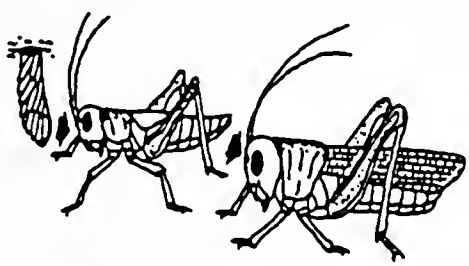
An understanding of the feeding habits of insects is important if food-removal management tactics are to be effective. Insects have different types of mouth parts specifically adapted to the environment they live in and the food they consume.

Mouth parts include:

- **chewing (e.g., grasshoppers),**
- **piercing-sucking (e.g., mosquitoes),**
- **sponging (e.g., house flies),**
- **rasping (e.g., fly larvae), and,**
- **rasping/sucking (e.g., thrips).**

Insects develop and grow by means of a series of different molts called instars or growth stages. The transformation of an immature to a mature insect is termed **metamorphosis**. The first type of metamorphosis is **ametabolous** or **simple metamorphisis**. This is an insect that hatches from eggs in a form that resembles the adult except that they are smaller. The adults do not have wings. The silverfish is an example. The nymphs live in the same habitat and feed on the same food as the adults.

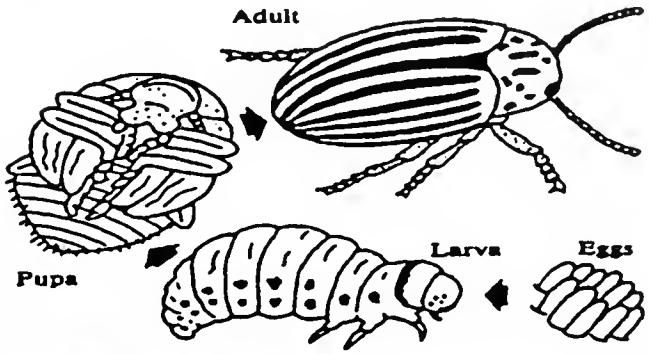
EGG ⇨ NYMPH ⇨ ADULT



The second type of metamorphosis is termed **paurometabolous**. This type of metamorphosis is similar to the type mentioned above. Adults have wings. This form can also be called **gradual metamorphosis**. Cockroaches, grasshoppers and plant bugs are examples of gradual metamorphosis.

The last type of metamorphosis is termed **holometabolus** or **complete metamorphisis.** The insect hatches from an egg to a larva to a pupal stage, then becomes an adult. The immature stages are very different in appearance from the adult. The adults and larvae most often feed on different materials. Often, their environments are quite different. Mosquitos and leaf beetles are examples.

EGG⇨ LARVA ⇨ PUPA ⇨ ADULT

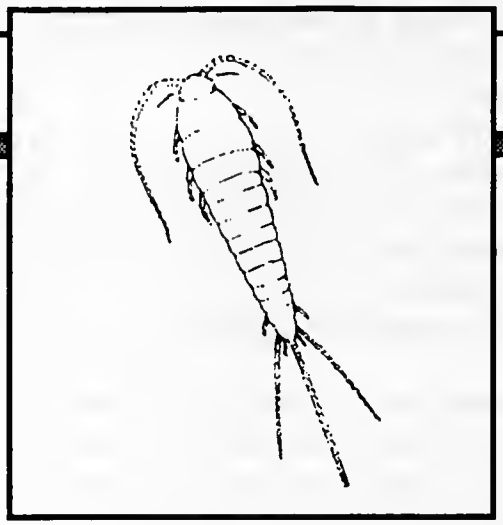


Metamorphosis of a beetle

When you find insects, don't run for a can of pesticide at the sight of one or two insects. Stop and think about the situation. Determine if the insect is causing damage in some way. What is the insect? Is it being a nuisance? Is it causing harm to the children or teachers? Is it causing damage to school buildings or to the school grounds? Is it a health concern? Then look at **all** the different ways to manage the problem and then pick the best one for the school situation.

The important things to remember in management of insect populations are: 1) to be aware of what is there; 2) is it a pest; 3) what is the damage; and, 4) how to manage it. This chapter will help school IPM specialists recognize potential insect pests, where to look for them and how to best manage the problem.

Silverfish, *Lepisma saccharina*



- Silverfish are 3/8 to 1/2 inch (8 to 12 mm) in length, silvery grey and covered with fine scales.
- The insect has chewing mouth parts, no wings and no metamorphosis.
- Silverfish are fast runners and can easily be identified by their long antennae and three pronounced tails.

Damage:

- These insects are nocturnal feeders and feed on cereals, glue, starch, bookbindings and paper products.
- They can severely damage books and papers in storage areas.

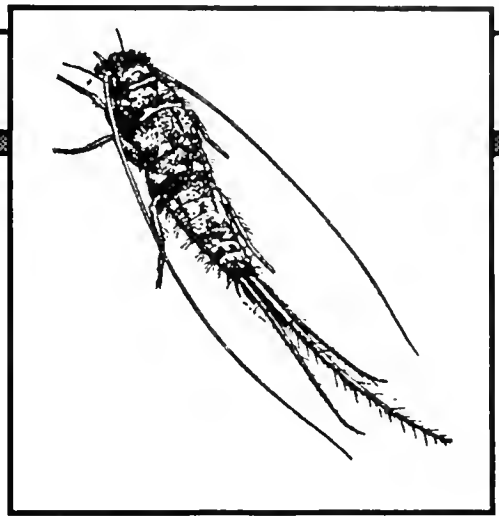
Habitat:

- Silverfish are found in cool, damp areas such as basements and storage rooms. They can also be found under boxes, boards and other debris.

Control:

- Long-term control can be achieved by modifying the environment of the insect.
  - The female lays the eggs singly in cracks and other secluded places. Therefore, sealing cracks can eliminate many problems.
  - Keeping areas clean of debris and not setting boxes, books, etc. directly on the floors eliminates many hiding places.
  - Removing sources of water and reducing the humidity in problem areas can eliminate a conducive environment.
- Insecticides can be used to treat places where silverfish hide, especially in cracks, walls, voids, attics and other hiding places.
- Traps can also be used. Place a glass jar that has been covered with masking tape where the silverfish will get into it, but not out, to help reduce populations. Sticky traps that are used to control mice also work well in catching silverfish when placed in the correct area.

Firebrats, *Thermobia domestica*



- Firebrats resemble silverfish; however, they are more mottled in color.
- A key identifying factor in distinguishing firebrats is their three long tail filaments. The silverfish have three short tail filaments.

Damage:

- Firebrats cause the same damage as silverfish.

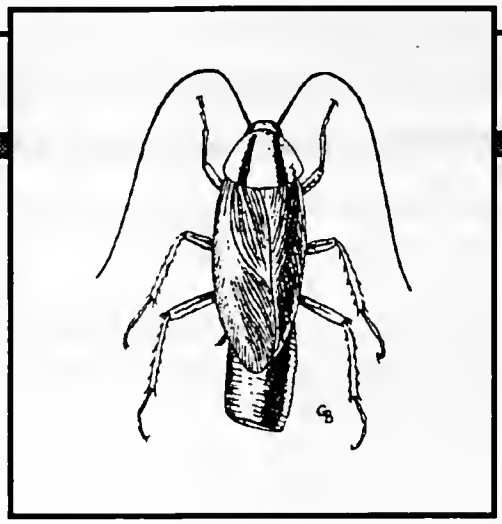
Habitat:

- Firebrats prefer warm hiding places. They can be found under heaters and under and around boiler areas. They like some of the same hiding places as silverfish.

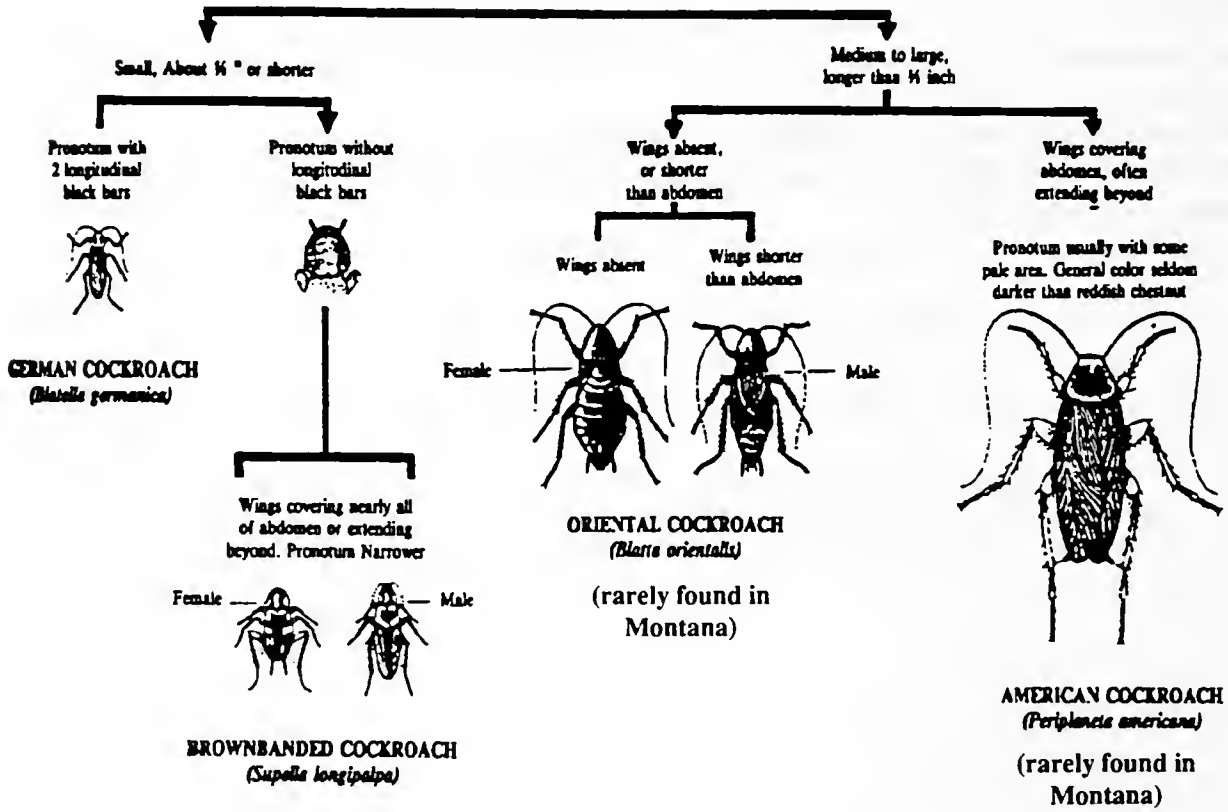
Control:

- Firebrats can be controlled in much the same way as silverfish. Manipulation of their environment is most effective. If air circulation is increased around heating units, it will make the area cooler and; therefore, less favorable to firebrats.
- Chemical control is the same as described for silverfish.
- Traps can also be used in the same way as for silverfish, but placed in warmer areas where firebrats are likely to hide.

German Cockroach, *Blatella germanica*



- The German cockroach goes through simple metamorphosis; egg, nymph and adult. The eggs are encased in capsules called **ootheca**. They have chewing mouth parts. Female German cockroaches carry their ootheca around with them (see illustration at right). This is one way of identifying this cockroach. Females will lay up to eight ootheca in their life time (average 250 days). Should the female die while carrying her ootheca, the eggs will also die.
- Adults are pale brown to tan in color and measure 1/2 to 5/8 inch in length. They have wings with two very distinctive dark stripes that run down the **pronotum** just behind the head.
- The German cockroach has the shortest life cycle of all cockroaches, but the highest potential for offspring production. One female can produce up to 400 young during her lifetime.



Cockroaches, continued

Damage:

- Cockroaches can spread diseases such as dysentery, diarrhea and food poisoning.
- The German cockroach and other cockroach species can soil areas with their salivary secretions and fecal matter, leaving an unpleasant odor.
- People may develop allergies as the result of the cockroach's molting process. Some people, especially people with asthma, may be sensitive to the shed skins of cockroaches.

Habitat:

- German cockroaches prefer environments that are moist and near a food source. This is why kitchens, areas where food is stored, bathrooms, under sinks and around plumbing fixtures are prime areas to find them. Favored hiding places are very small spaces, such as a crack, in which they are touched on all sides of their body. They are active at night.
- If German cockroaches are found outside these areas, it is a good indication that there is a very high population problem. German cockroaches will not leave their living environment unless the environment is disrupted in some way. Overpopulation or an application of a pesticide may cause them to leave their environment.

Control:

- Sanitation is the most basic and easiest way to prevent an infestation. Eliminating or restricting material that supports the cockroach population is an important step.

- Keep food in tightly sealed containers and do not leave food exposed for the cockroaches to eat.

- Promptly clean up food spills, garbage, food scraps, counters and sinks.

- Keep areas dry. Cockroaches need water to survive. Repair dripping faucets and leaky pipes, remove empty buckets and hang up mops rather than set them on the floor. Any pop bottles and cans that are to be recycled should be rinsed and stored outside and not in kitchen areas.

- Sealing cracks is an easy and safe way to help control German cockroaches. Caulking around pipes and other areas and putting screens over drains will provide barriers to favorite hiding places. Sink traps, drain pipes, toilet bowls, drainage pans under refrigeration units, and flush tanks are other water sources.

- Check materials being brought into the building for signs of cockroaches. Look for ootheca, fecal matter and the cockroaches themselves.

- Traps can be used for detection, monitoring and population reduction of the German cockroach. Correct placement of these traps is very important. Therefore, take time to identify the insect and learn about its habitat.

- Sticky traps can be used with or without bait. Bait includes beer, bread, potatoes, or raisins. Sticky traps will not eliminate the problem. Traps cannot kill the cockroaches that are hiding.

- Several good roach traps are on the market. They contain a bait and insecticide that the cockroaches carry into their hiding place where the insecticide can kill other cockroaches. Remember too, that when females carrying ootheca are killed, their eggs are usually killed.

- Controlling cockroaches chemically can be very expensive. Often, the cockroaches have developed resistance to the chemicals. German cockroaches are a prime example of this problem. Cockroaches will often disperse after an application of an insecticide.

- Chemical control, to be effective, has to be repeated. Often the chemical used will have some residual effect. Adult cockroaches that pass through the residue will pick it up on the spines and hairs on their legs and body and carry it into the cracks and crevices where they hide.

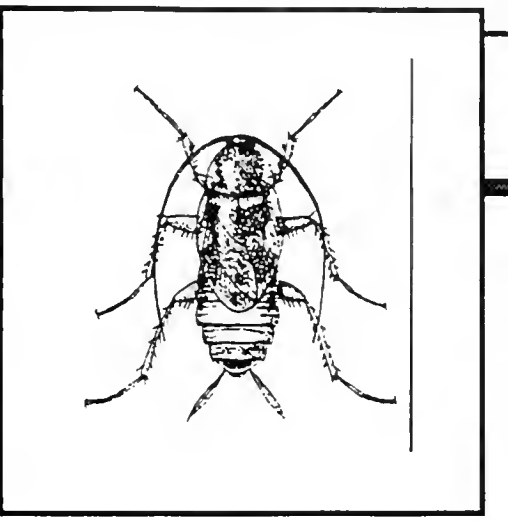
- When using chemicals to control cockroaches, concentrate on injecting the insecticide into the cracks and crevices that are the cockroaches' environment. To do so, use a small diameter extension tube in the infested cracks and crevices, under sinks, under furniture and around pipes. When treating cracks in cabinets and along shelves, remove all utensils and supplies first! NEVER TREAT SHELF SURFACES OR COUNTERS!!

- In nonfood areas, spot treatments can work well when they are used in a safe manner in an area no larger than two feet square.

- Aerosols and foggers are less effective, and often they only flush the cockroaches into new areas. Roaches are only killed when they come in contact with the residue. Aerosols and foggers cannot penetrate into cracks and crevices. This type of treatment needs to be repeated often and when no one is present in the rooms. Remember not to treat when food is present.

- Remember, no pesticide application used alone will control cockroaches satisfactorily without environmental or habitat alteration.

Brownbanded Cockroach, *Supella longipalpis*



- Brownbanded cockroaches go through simple metamorphosis. They have chewing mouth parts. The female will glue her ootheca to a surface in a dark area. This might be in cabinets, under chairs, or in drawers. For this reason, the brownbanded cockroach is easily transported to new areas.
- Brownbanded cockroaches are about 1/2 inch long. Females are reddish brown to dark brown and the male is dark brown. The key to identifying these cockroaches is the light band behind the pronotum at the base of the wings and another band or partial band about one third of the way back from the pronotum.
- The males will fly and are attracted to lights at night. The female does not fly.

Damage:

- The brownbanded cockroach causes the same type of damage as the other cockroach species.

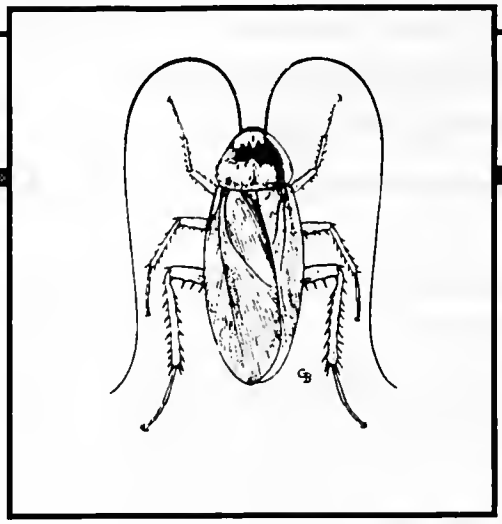
Habitat:

- Brownbanded cockroaches are most often found in kitchen areas. They prefer an area where the temperature is 80 degrees F or higher. They are often found in high cabinets, around stoves and near the warm motors of refrigerators, electric clocks, light timers and in television sets and radios.

Control:

- Control of the brownbanded cockroach is the same as used for other cockroaches.
- Collecting and destroying the ootheca can help reduce roach populations.

American Cockroach, *Periplaneta americana*



- Uncommon in Montana; rarely occurring.
- The American cockroach is the largest cockroach found in this area. They are typically 1-1/2 to 2 inches in length. They are reddish brown with yellowish edges and markings on the pronotum. There is a yellowish colored stripe along the front margin of each forewing. A distinguishing characteristic of the American cockroach is their antennae are longer than their bodies.

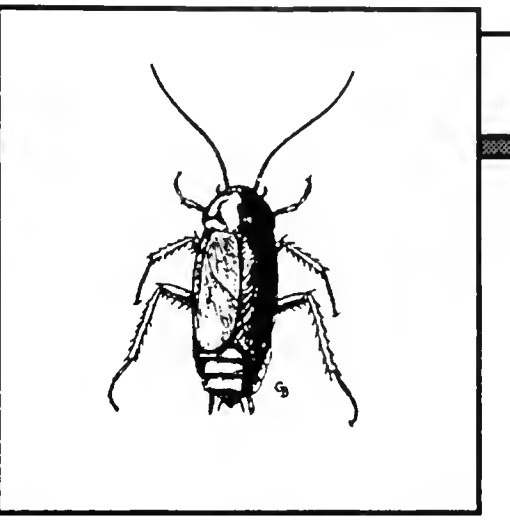
Damage:

- The damage caused by the American cockroach is the same as for the other cockroach species.

Control:

- Use the same environmental alteration and chemical tactics that are used for control of the other cockroach species.

Oriental Cockroach, *Blatta orientalis*



- Uncommon in Montana; rarely occurring.
- The Oriental cockroach varies in length from one to two inches. They are black or a very dark, reddish brown color. Like other cockroach species, they have chewing mouth parts. The key identifying characteristic is that the wings of the male of this species are short. The wings cover about 3/4 of their abdomen. The female has only wing "stubs." Another key characteristic is that the rear corner of the abdomen projects out. This gives the body a scallop shape. Therefore, the body looks as if it is rounded.

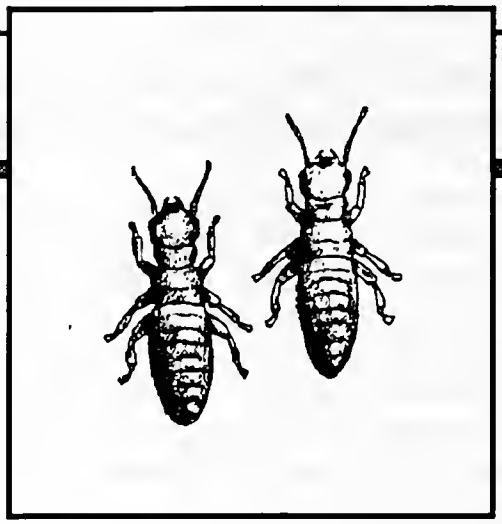
Damage:

- The Oriental cockroach causes the same type of damage as other cockroach species.

Control:

- The Oriental cockroach is controlled in the same way that other cockroach species are controlled.
- Environmental manipulation works well in controlling this species.

The Western Subterranean Termite, *Reticulitermes hesperus*



- Termite problems are infrequent in Montana, but serious damage can result when problems do occur.
- Western subterranean termites are social insects that live in colonies under the ground. The termites have a simple type of metamorphosis: egg, nymph, adult. The adults can be either workers, soldiers, or reproductives. The reproductives are either males (kings) or females (queens). Workers are 1/4 inch in length, soldiers 1/4 inch, and the reproductives are 3/8 inch in length. Both soldiers and workers are very sensitive to light and changes in moisture.

The following characteristics will help identify the western subterranean termite:

- Workers and soldiers have flat pronotums without elevated ridges behind their heads.
- Workers are grayish white and eyeless.
- The head of the soldier is twice as long as it is broad with very narrow, enlarged mandibles. Soldiers are also grayish white.
- The winged reproductives are black to dark brown. They have compound eyes and have two pair of wings equal in length (ant wings are unequal in length). After mating, the wings are shed or torn away and the adults enter the nest to start laying eggs. The queens and kings live together for life. The king usually attends the queen and they live together in a chamber separate from the soldiers. In this chamber, the two of them are tended to by a squad of soldiers. The queens can live up to three years.

Damage:

- Termites feed on wood and wood products that are rich in cellulose. The digestion of the cellulose is aided by a symbiotic relationship with a species of protozoan that lives in the termite's digestive tract.
- The termites do not live in the wood, but just feed on it. They can badly damage the wood, making structures weak and unsafe. Signs of damage include holes or tunnels in wood, or wood that feels weak or not solid when poked. Earthen tubes (mud) may be present on the outside of the structures. These tubes may be present on the concrete foundations. This species of termites do not produce "sawdust" because the wood is eaten and not bored out.

Habitat:

- Western subterranean termites live in nests in the soil. They do not live in the wood that they damage. They will enter into wood by feeding on any wood that comes in contact with the soil. Termites will also build mud tubes to reach wood structures over cement.

Termites, continued

- Termites will enter structures through the wood touching the soil, such as poles and posts, or through cracks in the building foundation.

Control:

To control termites, it is necessary to identify where they are located. To do this properly, take the following steps:

- All inspections should encompass crawl spaces under the buildings, the basement area and inside and outside of the building.

- Under the building, look for any soil to wood contact. This can be posts or poles directly on or in the ground, old wood or boards laying on the ground and old tree stumps in the ground. Check areas where there is excess moisture, areas of poor ventilation, or wooden form boards. Termites might be found in areas near the furnace, leaking pipes, or faucets. Check for cracks along walls and the foundation. Look for mud tubes which will indicate the presence of termites.

- Outside of the building, look for any wood that touches the soil. This could be wood siding, wood skirting, or wooden basement window frames. Look for discoloration or blistering of paint and warped or cracked wood siding. Check for cracks in the foundation and any mud tubes on the outside. Dispose of any piles of wood that may contain termites.

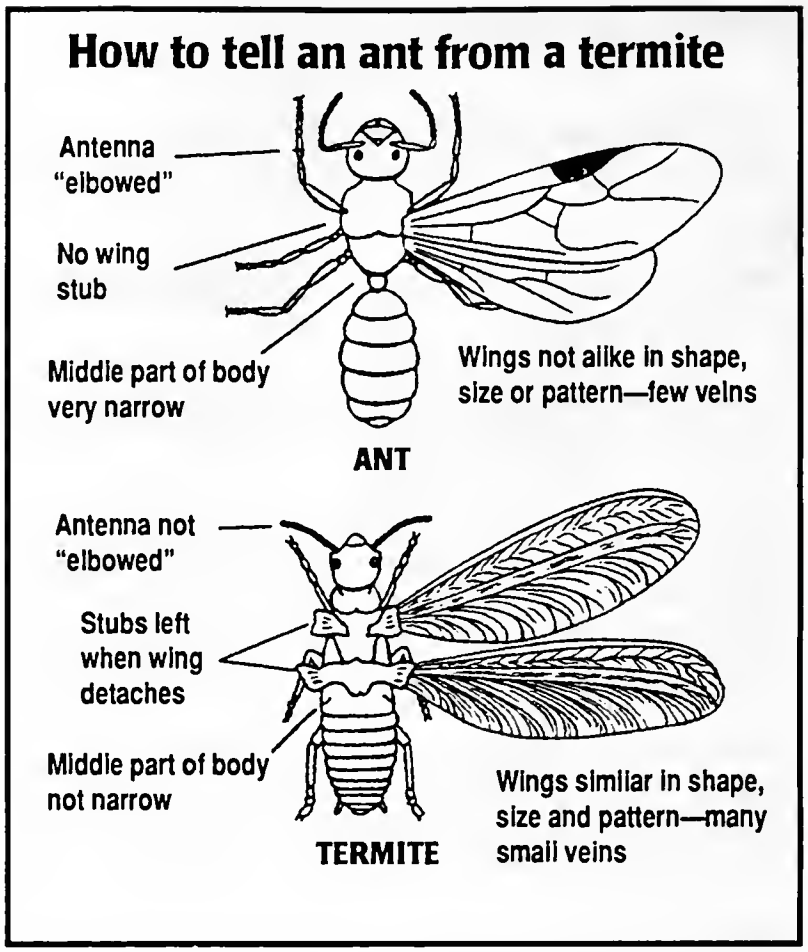
- Inside of the building check for termite damage and mud tubes around plumbing, under sinks, around toilets, near showers and under tubes. Look for water damage or stains on ceilings and walls, or along baseboards. Look for evidence of past swarming in windows sills (torn wings). Check floors for warping, sponginess, or weakness.

- When searching for termites, the following tools are useful: coveralls, safety helmet, flashlight, screwdriver, hammer, ladder, moisture meter, pencil, clipboard, measuring tape and a caulking gun.

- Preventative practices can reduce the chances of termites and other wood-destroying pests attacking wood structures.

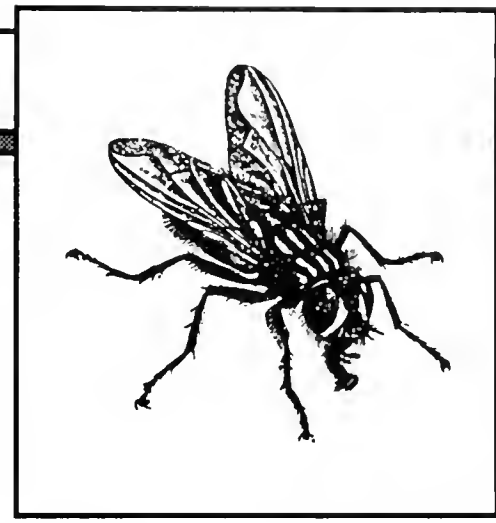
- Cut off the termite's soil to wood contact is important. One of the easiest ways to disrupt or alter a termite's environment is to use a sand barrier. Subterranean termites cannot tunnel through fine, dry sand because their galleries collapse. Termite nymphs can make their way through spaces of pebble size, or larger than 1/8 inch in diameter. They can also tunnel through fine sand if it is moist. Termites cannot penetrate a barrier of sand and grit with spaces smaller than 1/8 inch and placed in a 20-inch wide band on the soil surface, or in a trench next to the foundation.

- Sanitation and structural control are simple methods that can prevent problems. Remove all wood and other material containing cellulose from under or around the building. Remove any soil that comes into contact with the wood structures of the building. Replace weak structures with metal structures. Fill all cracks and crevices where they enter the structures. Provide good drainage inside and outside of the building (eaves, drains, water taps).
- Plant trees and other woody plants away from buildings to help keep termites away.
- Use wood that is naturally resistant to termites, such as foundation grade California redwood, all-heart southern tidewater red cypress or other treated wood material. These materials are quite resistant, but not totally safe from termites.



- Chemical treatment is often the only means to disrupt termites once they have become established in a building. Usually, the chemicals form a protective barrier through which the insects cannot pass. Great skill and knowledge of termites is needed to treat termites successfully with chemicals. Since the chemical control of termites is complex, it is generally best to use a trained professional. *Some methods used to control termites with chemicals are the following:*
- Trenching: This involves digging a 6-inch wide trench in the soil adjacent to the foundation wall. This trench will usually be 3 to 12 inches deep, depending on the type of building foundation. The pesticide is then applied along the sides and bottom of the trench and the dirt is filled back in.
- Rodding: This involves using pipes. The pipe should be about four feet long and 1/2-inch in diameter. A handle and shut off valve is placed on one end. Holes are drilled in the other end of the pipe so the insecticide moves out in all different directions. These pipes are placed in the soil about six inches from the foundation and about one foot apart. The chemical is then injected into the soil.
- Sub-slab injection: A special tool called a "the sub-slab injector" is placed in a hole drilled into a concrete slab to introduce the pesticide into the soil under the slab. When drilling into the concrete, be careful where the holes are drilled. Do not drill into pipes or electrical wires.

House Fly, *Musca domestica*



- The house fly is gray with four black lengthwise stripes on its thorax. Its abdomen is gray or yellowish with a dark midline and irregular dark markings on the sides. The large eyes are compound and reddish. House flies go through complete metamorphosis and have sponging mouth parts. They have only one pair of normal wings that are clear. They have a second pair that are two knobbed organs (**halteres**). These halteres help to stabilize the fly during flight. House flies range in size from 1/8 to 1/4 inch in length.

Damage:

- House flies, because of their habits, come into contact with humans in many different environments and situations. In most cases, flies are a serious nuisance pest. The larvae almost always develop and feed on some type of man-made product that becomes their source of food. Such food sources might include garbage, animal waste, fruit and vegetable waste or spoiled food. The adults feed on a wide variety of food. This food might be liquid or solid. Adults are most commonly associated with spreading disease from their feeding habits. When they feed, they will move from one source to another. Also, when they feed on solid food, they regurgitate an enzyme to help break down the food so that it can be lapped up with their mouth parts. This habit makes it easy for flies to spread organisms from one place to another. House flies are associated with transmitting typhoid fever, cholera, dysentery, pinworms, hookworms, some tapeworms and other germs.

Habitat:

- House flies can be found any place where garbage or rotting organic matter is located. They are found worldwide, except in Antarctica and a few remote islands.

Control:

- The most basic and fundamental control measure for flies is sanitation. Removing breeding sites is extremely important.

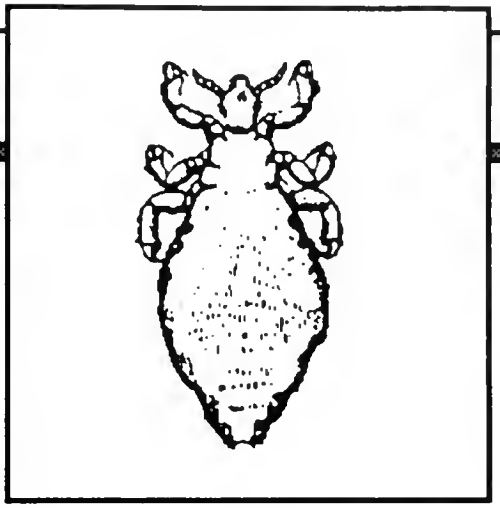
- Regularly remove trash or keep it covered with tight-fitting lids.

- Clean up food and drink spills promptly.

- Discard food scraps and promptly wrap, seal and put away leftover food.

- Screens and other exclusion techniques are important management tools.
- Caulking or covering holes and other openings into buildings helps to prevent flies from entering the building.
- There are also several traps on the market that work well. Traps work best in areas that are combined with other exclusion methods, such as screens.
- Fly "stick" traps work well in catching flying flies in an area.
- Electronic light traps can also kill flies.
- There are also various "bait" type traps available for sale. These usually contain a protein bait, sometimes with a **pheromone** (sex attractant) added.
- Insecticides used for fly control are most successful when used as a supplement to other control methods. There are many flies that are difficult to control because they have developed resistance to some insecticides.
- Spot treatment in areas that are frequented by the flies works the best. Dark corners where flies like to rest are ideal for spot treatment. Other hiding places can be found by observing the flies and their habits.
- These control methods can be used for many different types of flies that may become a problem.

Head Louse, *Pediculus humanus capitus*



- Lice are wingless parasites that live on humans. They are 1/16 to 1/8 inch in length and gray. Their head is slightly narrower than the thorax and often half as wide as the abdomen. The legs have sharp claws which they use to grasp hair.

Damage:

- A louse bite is painless, but the saliva it excretes causes an allergic reaction that produces itching. This itching may not occur for several weeks in some people. Scratching can cause open sores which may allow germs as well as lice fecal matter to enter the skin and cause secondary infections. Severely infested people may develop a fever and feel tired and irritable. Although irritating, head lice are most often just a nuisance.

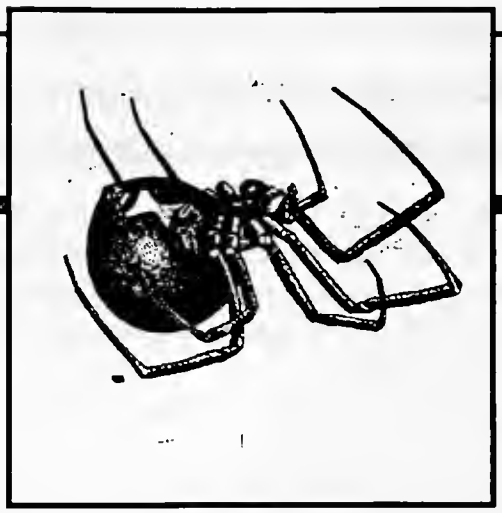
Habitat:

- Lice eggs (nits) are laid on the head hairs at the base where the hair and the skin come together. The egg is coated with a glue-like substance that cements the egg to the hair.
- Head lice can move quickly, but do not fly or jump. The lice are transmitted from person to person when an infested person comes into contact with another individual. The lice and nits can also be transmitted when combs, brushes, caps, hats, scarves, coats, bedding and towels are shared.
- Head lice are most commonly found on school children from age 3 through 10.

Control:

- Head scratching is one of the first signs of a lice problem. A quick look at the scalp will reveal if any lice or nits are present. A special light with a magnifying glass is a handy tool for school nurses to use when looking for head lice. These lights are available from medical supply stores.
- Education of the community is the most important part of controlling an infestation in a school situation. Often, teachers and/or parents are afraid to talk about lice problems because of the stigma of lice being associated with filth, poverty and poor personal hygiene. In truth, cleanliness has very little to do with an outbreak of lice in the school.
- Providing a separate storage locker or cubbyhole where students can store their coats and hats is a good way to keep children's clothing separate. This practice reduces the odds of lice spreading from one child to another.
- The least toxic management program requires four things.
  1) Application of heat (hair dryers work well).
  2) Combing the hair.
  3) Washing clothing and bedding.
  4) Shampooing the hair with soap.
- The best treatment is to use insecticidal shampoos. They can be purchased at any drug store. This treatment should be used in combination with combing. Use a special thin tooth comb for this.

Black Widow, *Latrodectus mactans* and *Latrodectus hesperus*.



- Black Widow spiders are common throughout the Rocky Mountain area and may be found at elevations up to 8,000 feet.
- The female spider is about 1/2 inch in length and shiny black or dark brown. Most black widows will have an orange-red, hourglass shaped marking, on the underside of her abdomen. In Montana, this mark may be absent. The male is similar in color, but is much smaller and does not have the reddish markings.

Damage:

- All bites to humans are from the female black widow spider. Often, it is because she is guarding her egg sac. The venom is a nerve poison. Often the original bite is not very painful, but might be followed with a burning sensation, local swelling and redness. The pain may be intense for one to three hours after being bitten and last up to 48 hours. A victim may experience cramping of the legs, arms and chest. In many cases, the abdominal muscles become rigid.
- Anyone bitten should seek prompt medical attention. Bites are rarely fatal but the symptoms are very painful.

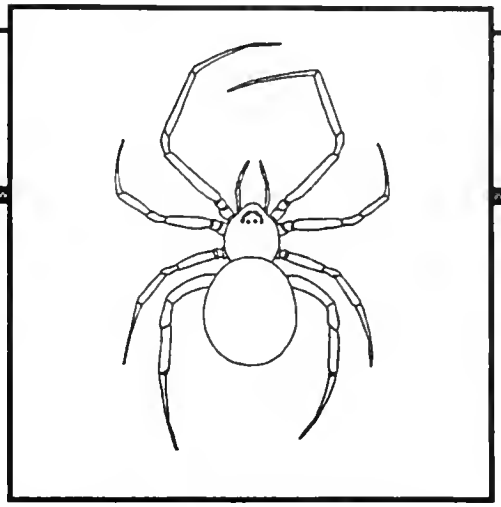
Habitat:

- Black widows are typically found in shrubbery, log piles, crawl spaces, under porches, in garages and in piles of debris.

Control:

- It is important to teach children what black widow spiders look like and the danger that may result from being bitten.
- One of the easiest control methods is to crush the spiders when they are located. By nature, the Black Widow is not an aggressive spider and will not bite unless provoked.
- Some problems can be reduced by removing debris, or by modifying hiding places where the female may frequent.

Aggressive House Spider, *Tegenaria agrestis*



- The aggressive house spider has plumose hairs on its cephalothorax and abdomen.
- Its legs are a light solid brown. The nonpoisonous spiders of this genus have banded legs.
- The aggressive house spider can be differentiated from other funnel spinning spiders by the eight eyes with both anterior and posterior eye rows in a line.
- These are very large spiders, about 1-1/2 inches in length, and they are very fast runners.

Damage:

- Both the male and female spiders will bite. The male is more venomous than the female. The venom causes sever necrosis (tissue death) and sloughing of skin in the bite area. Lesions may take up to six months to heal.
- Dogs and cats may die when bitten by the aggressive house spider.

Habitat:

NOTE: The bite of the aggressive house spider is sometimes mistaken for and misdiagnosed as a brown recluse spider bite. The brown recluse is not found in Montana.

- Aggressive house spiders can be found in and around buildings.
- They build funnel type webs in all habitats.
- The spiders are very common is rock walls, along house foundations, in garages, in piles of discarded lumber and other debris and in stacks of firewood.
- These spiders move indoors when the weather starts to turn cooler from August to October.
- The aggressive house spider is established in Western Montana and occasionally transported into eastern areas of the state.

Control:

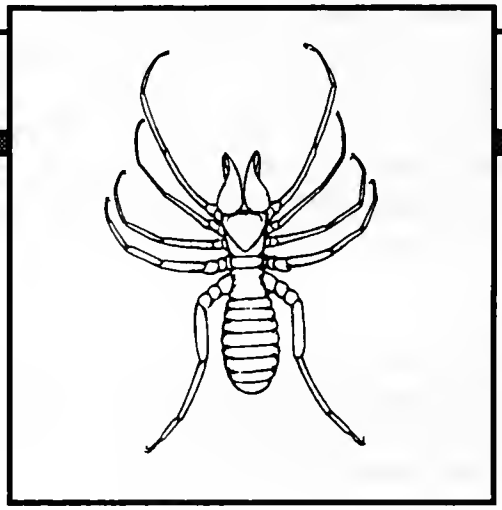
- Eliminate piles of wood and other debris near buildings, eliminate grass growing directly against the building foundation and seal cracks and crevices where the spiders might enter the building.
- Vacuum up the spiders, then freeze, burn or treat the bag with an insecticide labeled for spiders.
- Crush the spiders when possible.
- Remove the overwintering egg sacks from under rock and wood piles. Be sure to wear thick gloves when removing the egg sacks to help protect yourself from bites. It is also a good idea to use long forceps (10 inches or longer) to grasp the egg cases.
- Using a perimeter spray with a pesticide can help reduce populations. Males, looking for a place to enter a building, will crawl through the area treated in search of females. The problem with

perimeter spray is that it can take up to five days for the spiders to die because the spiders are not in contact with the spray long enough.

- Fumigation is not effective. It only kills the spiders in the area being treated at that time. It will not kill spiders that enter the area later.

SOLPUGIDA

Sun Spider (Wind Scorpion)



- Sun spiders are yellowish brown and range from 3/8 inch to two inches in length.
- They are most easily identified by their long pair of pedipalps on the sides of their head. These pedipalps appear as if they are a fifth pair of legs.
- Sun spiders have a pair of greatly enlarged mandibles (or jaws).
- Sun spiders run very fast; thus, the name wind scorpion.

Damage:

- On occasion, sun spiders will enter buildings. This is especially true during the summer months.
- Because of their appearance, these creatures may cause alarm. They rarely bite unless they are handled or crushed inadvertently. The bite can be painful, but the pain is not persistent.

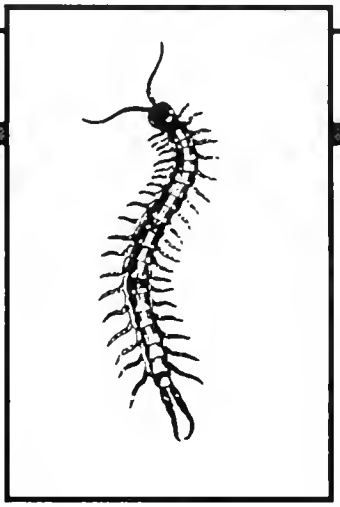
Habitat:

- Sun spiders are common in Montana. They are not very common at the higher elevations. They feed on insects and small vertebrates, including lizards.
- The female will lay her eggs in a subterranean burrow. There, she will guard over the eggs and the young for several weeks until the young molt for the first time.

Control:

- Move material where sun spiders may hide, such as rocks, wood piles and other debris, away from building foundations.
- Perimeter sprays with insecticide may also work.
- Sun spiders seldom cause much of a problem in buildings. The occasional one that enters can be crushed.

Centipedes



- Centipedes have one pair of legs per body segment.
- They are flattened and are 1 to 1-1/2 inches in length.
- Centipedes are usually brown.
- Centipedes are very delicate and their legs are easily broken.
- These animals are quick runners.

Damage:

- Centipedes are not much of a problem. There have been no reports of humans being bitten.

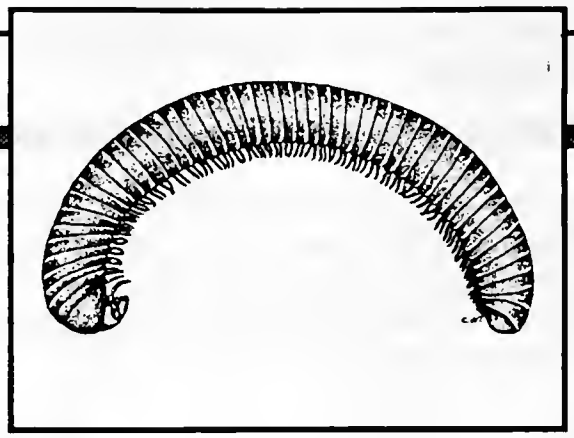
Habitat:

- The house centipede likes to hide in moist places, such as basements, closets, bathrooms and under sinks.
- They are usually active at night or in dark areas.
- Often, centipedes will be found gathered near lights to catch flying insects.

Control:

- The best and easiest control for centipedes is to modify their environment. Remove moist or damp hiding places such as mulch, wood chips, leaves or rotting wood near foundations.
- Fill in cracks and crevices so that centipedes cannot enter the building.
- Centipedes are beneficial. They capture other insects that may be pests and it is best not to control them.

Millipedes



- Millipedes are commonly known as "thousand-leggers." They have two legs per body segment.
- They are usually one inch or less in length and brown to black.
- Millipedes are long, cylindrical and wormlike in their appearance. Their bodies are protected by a hardened outer shell.
- They are slow-moving and will often curl up and remain motionless when they are touched.

Damage:

- Millipedes do not cause any real damage. They can become pests when they invade buildings.

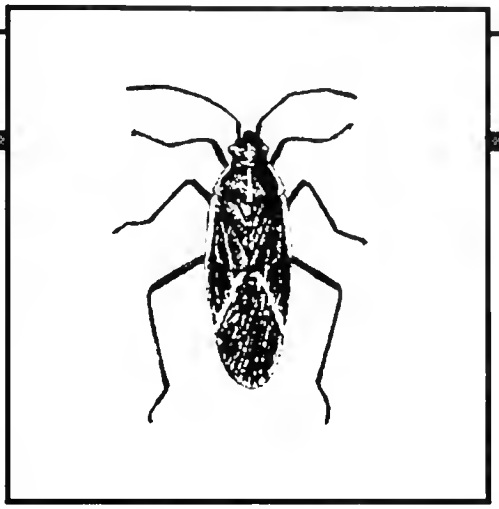
Habitat:

- Millipedes breed and feed in moist, damp, dark places. They can be found in wooded areas and lawns and gardens with very high organic matter. They feed on vegetable matter and dead insects.
- Millipedes will enter into buildings during periods of high rainfall.

Control:

- Environmental manipulation is the best way to control millipedes. Removing rotting or organic material such as mulch from around buildings works best.
- Inside buildings, remove the source of the moisture by fixing leaks and cleaning up spills.
- Seal cracks around doors and windows to prevent entry.

Boxelder Bug, *Boseia trivittata*



- The adults are approximately 1/2-inch in length and are dark brown or black with conspicuous red markings on the back part of their body. The immatures are smaller and are solid bright red in color.

Damage:

- Boxelder bugs most often become pests when they enter buildings in the fall or try to exit buildings in the spring after hibernation. They can be most severe along the south and west sides of buildings. They rarely bite but can cause staining on curtains, drapery and other resting spots from their fecal matter.
- When they are crushed, they give off a foul odor.

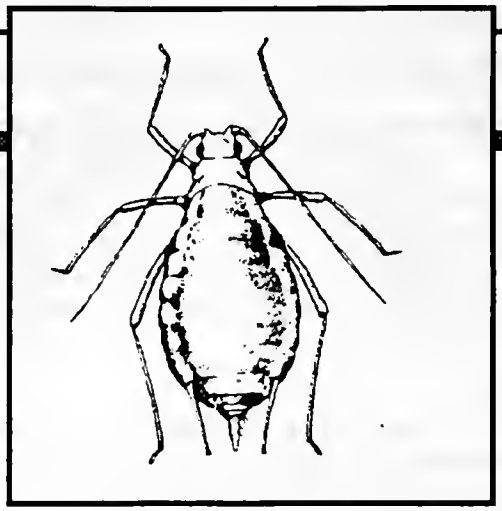
Habitat:

- Boxelder bugs (first generation) will develop and feed on seeds produced by the boxelder tree and occasionally on maple or ash trees. The developing boxelder seeds that are produced by the female tree are the primary food source of the second generation of boxelder bugs. During the fall, the adults search for protective places to overwinter. They choose places that are warmed by direct sunlight and retain heat. This makes buildings the perfect place for the boxelder bugs to overwinter.
- Boxelder bugs will not reproduce indoors.

Control:

- To prevent boxelder bugs from entering buildings, seal openings where they may enter. Pay particular attention to the south and west sides of the building. This is best done before it gets cold and the boxelder bugs start searching for places to hide.
- Boxelder bugs can be vacuumed and the bags disposed of or destroyed.
- The best spray control is with a direct application of a soap and water mixture. To increase the effectiveness, provide a suitable hiding place for the bugs (a flat board) and apply the soap and water mixture as a spot mixture.

Aphids, Aphididae family



- Aphids are small, soft-bodied insects and are 1/8 inch or less in length. They have piercing-sucking mouth parts.
- Aphids can reproduce **viviparously** (nonsexual, live birth) or sexually. They go through incomplete metamorphosis.
- Adults may be winged or wingless.
- Aphids are distinguished from other insects by a pair of **cornicles** (tube-like projections) near the hind end of their bodies.

Damage:

- Aphids damage plants by feeding on them. This feeding can slow the plant's growth, cause it to lose its leaves and the leaves may yellow or curl. Aphids also are vectors or carriers of certain plant diseases.
- Aphids also produce honeydew, which is harmless to plants, but attracts ants and other insects. This honeydew sometimes creates a sticky mess on trees, plants, on sidewalks and on cars that are under the trees. The honeydew often supports a black, sooty mold that darkens the plant leaves.
- During warm weather, aphids can go through one complete generation in two weeks. For this reason, and the fact that they can give live birth, populations can increase very quickly.

Habitat:

- Aphids are found on all different types of plants and trees.
- Aphids tend to occur at the tips of branches, on newer growth.

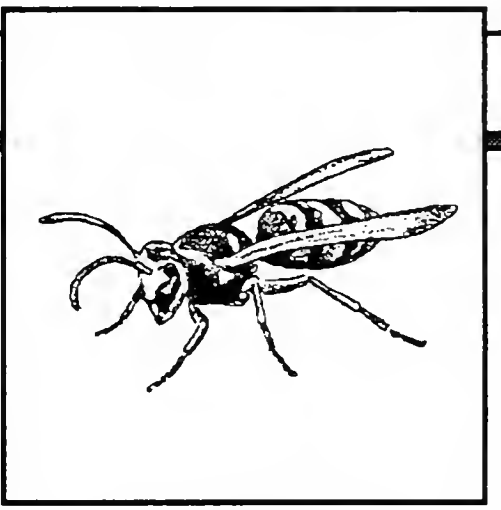
Control:

- There are many beneficial insects that will normally control aphids. Some of these natural enemies include ladybird beetles, lacewings and aphid-eating midges. Sometimes these natural enemies appear after the population of aphids has gotten out of hand. If aphids cannot be tolerated, it is best to spot treat them.
- The least toxic spray treatment is an insecticidal soap. This solution works well but is only temporary. It will kill the aphids on contact but does not have any residual action, so several applications might be needed during the season.
- Aphid populations are highest on plants with high nitrogen levels. These are typically areas where new foliage is growing. Also, applying nitrogen fertilizers can cause problems since it enhances aphid reproduction. For this reason, don't over fertilize with nitrogen. It is best to use slow-release fertilizers.

- Pruning portions of the plant that are affected works well. Cut off the branch or portion of the plant that the aphids are on and dispose of it.
- Spray the aphids with a 2% horticultural oil. It is not toxic to humans and will kill the aphids on contact. It will also kill the eggs that are laid in the fall and overwinter.
- Several organophosphate, carbamate, pyrethroid and other broad spectrum insecticides can be used to control aphid outbreaks. Some pesticides are ineffective because the aphids have developed resistance. Some pesticides kill off the beneficials and the aphid populations can rise quickly.

HYMENOPTERA: Bees, Wasps, Ants, Sawflies

Social wasps, *Vespidae*



- This family of wasps include the muddaubers, yellow jackets, hornets, digger wasps, common wasps and the paperwasps.
- Wasps go through complete metamorphosis and have clear, membranous wings.
- Almost all of the serious stinging and nuisance wasps belong to this family.
- Vespids are medium size to large size wasps. They range from 1/8 to 3/8 inch in length.
- A key characteristic of this family of wasps is that when they are resting they fold their wings over their abdomen and the wings appear to be pleated.

Paper Wasps, *Polistes spp.*

- These wasps are 1/2 to 1 inch in length and are very slender. They have a short **pedicel** or "waist" and are mostly reddish brown to black with yellow rings and reddish areas on their abdomen.

Yellow Jackets, *Vespula spp.*

- These wasps are 1/2 to 5/8 inch in length. Their bodies are stout and slightly wider than their heads. The head, thorax and abdomen are black and yellow or, black and white.

Sandhills Hornet, *Vespula arenaria.*

- These wasps are 5/8 to 3/4 of an inch in length. They are black with bright yellow on the sides of their head, thorax, legs and across each abdominal segment. Their wings are smoky.

Bald-faced Hornet, *Vespula maculata.*

- These wasps are 5/8 to 3/4 inch in length. Their head is much shorter than it is wide. It has black and white patterns on its face, thorax, abdomen and the first antennal segment. Their wings are also smoky in color.

Damage:

- These insects can cause numerous, painful stings. One wasp can sting many times. The social wasps feed on protein-rich foods such as insects, meat and dead animals. Yellow jackets are usually the most common pests wherever food is found. They are also the most aggressive. Late in the summer, yellow jackets will begin to feed on more sugary foods. They are attracted to soft drinks, other food material and trash. They are persistent and will bite and sting when swatted, disturbed or angered.
- All species of social wasps are aggressive when disturbed.

Habitat:

- Many of the social wasps will build paper-like nests. They construct these nests out of wood fiber or dead plant material which is worked into a paste with saliva from the adult's mandibles.
- The female (queen) emerges in the spring and searches for a place to construct her nest. **Nests are abandoned in late fall and are not used again.**
- The sites chosen by the queen depend on the species of wasp. Some prefer under eaves or overhangs, treetops, a hollow tree, wall or attics.
- The bald-face hornet builds very large nests and prefers an aerial location such as a tree limb, under an over hang on buildings or abandoned buildings (sheds). The adults are very protective of their nests and will sting repeatedly when disturbed.
- Yellow jackets build their nests in cavities in the ground, but will sometimes be found under eaves.
- The sandhills hornet constructs a paper nest (globular in construction) either under eaves or in shrubs. This wasp will sting viciously when its nest is disturbed.
- Paper wasps, construct uncovered paper-like, hanging nests. These wasps are much more tolerant of people and minor disturbances.

Control:

- Control can be rather simple once the wasp nest has been located.

- Wasps with aerial nests are best controlled with direct sprays that are directed to the nest opening. The best sprays to use are ones that have a quick "knockdown" ingredient (pyrethrins, resmethrin) combined with a persistent insecticide. Many of the wasp and hornet sprays on the market have this combination. It is best to check the label before purchasing the product.

- The ground nesting wasps are best controlled using a dust insecticide. The wasps will track through the dust and carry it into the nest. There it will be picked up and passed to other wasps.

- The best time to be around wasp nests while doing any type of control is very early in the morning or in the evening. The wasps are less active at these times. It is also best to dress in light-colored clothing and protective clothing including netting and gloves. Wasps are less aggressive toward lighter colors (white, tan).

- Sometimes it might be best to simply leave the nests if they are in locations where they will not pose a danger and allow the wasps to vacate naturally in the fall.

- Yellow jacket populations or stinging problems can often be reduced greatly through sanitation.

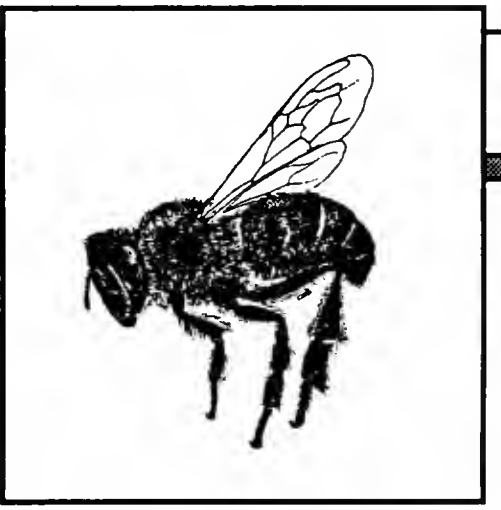
- The most important human source of food to yellow jackets is garbage. Using cans with good, tight-fitting lids is essential. This can greatly reduce yellow jackets in an area. Cans should be emptied often and lids and the outside of the containers cleaned. This includes trash dumpsters. Keep the lids closed and frequently wash them inside and outside. If the yellow jackets cannot find a food source, they will not be a problem.

- Areas where soft drinks are served may attract yellow jackets. The insects will be readily attracted to open cups and containers and will feed on the sugary substance. Disposing of the cans right away in covered trash containers, using cups with lids and using straws can reduce problems. Checking the drink before you swallow can prevent stings.

- Trapping yellow jackets is often helpful in reducing numbers. Many good traps are sold. These traps drown the yellow jackets in a sugar or soap solution and can be very effective if used for short periods of time. Traps should be emptied every four to six hours when large numbers of yellow jackets are being trapped.

- If the underground yellow jacket nest can be located, cover the entryway with a transparent bowl during the night. When the yellow jackets try to exit, they will become confused by their inability to escape. They will not dig an escape hole and will soon starve to death.

Honey bees, *Apis mellifera* and Bumble bees, *Bombus spp.*



- **Honey bees** are social insects that live in colonies and go through complete metamorphosis: egg, pupa, adult. The adults can be nonreproductive females (workers), males (drones) or reproductive females (queens).
- Drones are 5/8 inch in length, robust and have large compound eyes. They lack stingers and, therefore, do not sting. Their only purpose is to mate with the queen.
- Worker bees may be encountered as they gather nectar and pollen for the hive. They are the smallest honeybee, about 3/8 inch in length. They may sting when aggravated, particularly if near the hive. Honey bees can only sting once in their life time. The stinger is barbed and, once inserted into the victim, it is ripped from their body.
- The queen, who is the largest honeybee, is 3/4 of an inch in length. After mating, she will remain in the hive for her entire life (2 to 3 years) unless the colony swarms.

- The queen, workers and drones are mostly reddish brown and black with paler, usually orange to yellow rings on their abdomen. The heads, legs and antennae are black with dense hair on the thorax.

Bumble bees are social insects that live in colonies and go through complete metamorphosis. As with the honey bees, bumble bees also have drones, workers and a queen. The queen is the only member of the bumble bee colony that will overwinter and survive until the following spring.

- Drones are 3/8 to 5/8 inch in length. Their duties are the same as male honey bees.
- Workers are 1/2 to 3/4 inch in length. They assist the queen and gather nectar and pollen for the colony. The workers will sting but they are quite sedate and cautious when around humans. They do not defend their territories as other bees and wasps.
- Queens are the largest bees and are 3/4 to 1 inch in length. Their job is to reproduce.
- Bumble bees are easy to recognize with their distinct coloration and pattern. Their heads are mostly black. There is a black band between the two sets of wings. Their abdomen is yellow and black. The wings are smoky.

Damage:

- Little damage is caused by honey bees or bumble bees. By using good sense and caution, it is possible to avoid any aggressive behavior or stinging.

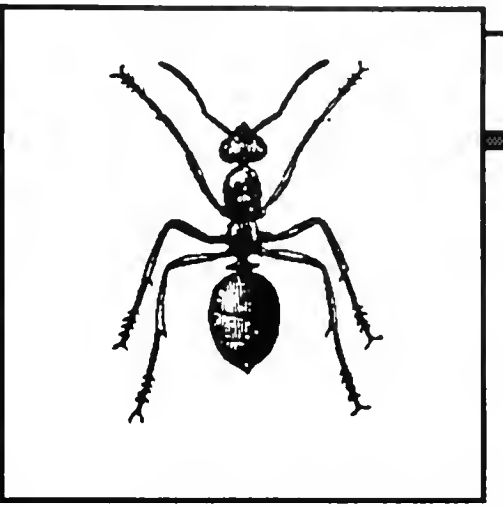
Habitat:

- Honey bees in the wild will live in colonies built inside of empty tree stumps, hollow logs, wall voids, attics or other places where they can hide. Sometimes, swarms can be found under eaves, in trees and in attics. Honeybee hives are occupied for years.
- Bumble bees build their nests in the ground. Occasionally, nests are found in a wall void. Each year the queen will enter the soil through an opening and construct honeypots and brood cells. Bumblebee nests are abandoned each year.

Control:

- The best way to control honey bees and bumble bees that are a nuisance is to use one of the wasp and bee sprays with quick knockdown and a residual insecticide. Most of the time, these bees are not much of a problem.
- Destroying the nests, if they can be found, and taking care to protect yourself, is an alternative.
- Plant flowers and other nectar and pollen producing trees and plants away from playgrounds and athletic fields to help keep bees away from these areas.
- Provide a physical barrier such as screens in windows to prevent the bees from entering into the building. Plant flowering plants away from windows to help keep honey bees away from the building.
- Remember, remain calm if a bee does enter a building. Most often they are not aggressive unless swatted. They will eventually find their own way out, die or you can use an insecticide to destroy them.

Ants, *Formicidae* family



- All ants go through complete metamorphosis and are social insects.

- **Field Ants, *Formica spp.***
  - These are medium sized ants, 1/10 to 1/4 inch in length, and may be brown, black or red or a combination of these colors.
- **Cornfield Ants, *Lasius alienus.***
  - These ants are small, just 1/10 of an inch in length. They are brown or black.
- **Carpenter Ants, *Camponotus spp.***
  - There are several species of carpenter ants that can be found in Montana. They are the largest ants in the region. They range in size from 1/4 inch to 3/4 inch in length. Often they are black or dark brown, some species may be lighter and have a red thorax. Carpenter ants are large, have a distinctly rounded thorax with no indentation and there is only one notch on their petiole (area between the abdomen and the thorax).
- **Harvester Ants, *Pogonomyrmex spp.***
  - Harvester ants are fairly large in size. They are 1/6 to 1/3 inch in length. They are red or dark brown.

Damage:

Most of the ants that have been described only cause nuisance problems, with the exception of carpenter ants. The problems occur when the ants are outside foraging for food and enter school buildings, or their nests may be located where they are unwanted, such as in lawns, playgrounds, or athletic fields. Some of the more serious types of damage caused by ants are described in more detail as follows:

- Carpenter ants can be one of the most destructive insects. They excavate nests in wood but, unlike termites, do not eat the wood. These ants become problems when they nest in wood in buildings. The galleries they dig in the wood will weaken it. They almost always nest in wood that has been softened by water or decay. These ants do not sting but can produce a painful pinch from their mandibles.
- Harvester ants cause damage to playgrounds, lawns or athletic fields by clearing vegetation from the area around their nest mounds. They rarely enter buildings and if they do, will not survive for long without soil to build their nests. Harvester ants can sting and do produce a painful wound. Children, because of their tender skin, are at higher risk of receiving stings than adults.
- Field ants do not have a stinger, but can pinch thin areas of skin and secrete formic acid that can produce short-lived pain.

Habitat:

- All of the ants that have been described normally live outside. Field ants are the most common ants found around buildings. They nest in loose soil. They can make mounds up to a foot in diameter. Their mounds are the ones most commonly seen in lawns and gardens. Carpenter ants live in dead, rotting or decaying wood. Harvester ants build large mounds above their nests.

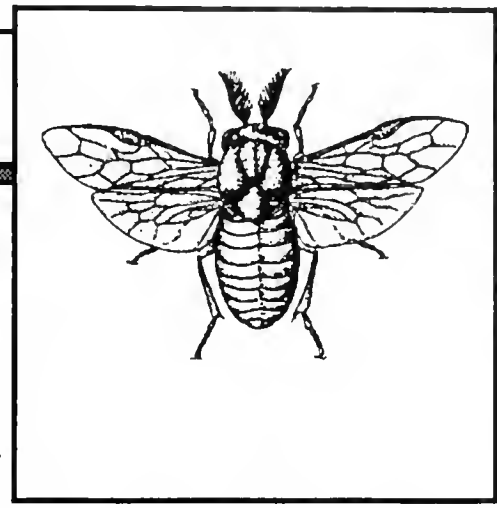
Control:

- Sanitation and environmental manipulation is a big part of control. Removing attractive food is a very important part of any control program. Once a source of food has been located by the ants, they will keep returning to these areas. Watch to see where the ants are entering the building. Then the cracks or crevices can be sealed. Be sure to clean dishes properly in the kitchen area or in lounges where food may be served. Clean all counters properly after use. Sweep floors and properly cover, wrap and remove extra food. Empty trash cans every day. Rinse bottles and pop cans, and if possible, store them outside.
- The use of baits or traps works well. There are several traps on the market. You can make your own bait from boric acid. Mix boric acid with honey or jelly at a 1 to 5 percent concentration (1 tsp. boric acid to 1 cup of honey or jelly). Then place the bait in an area the ants will find and feed. Ants will die in 10 to 14 days.

** **CAUTION:** Although boric acid is relatively non-toxic to humans, it should be used with care to prevent children and animals from coming into contact with the bait. Place the bait in out-of-the-way areas in enclosed "bait stations" such as jars with holes punched in the lids. If dead ants are found around the bait stations, decrease the boric acid. You want the ants to carry the bait back to the nest to kill underground portions of the colony. Conversely, if ants are still present after two weeks, increase the amount of boric acid in the bait.

- A perimeter spray treatment may prevent nuisance ants from coming inside. The insecticide should have residual action and be applied around the foundations.
- For a more permanent control, locate the nest and destroy it. When the nest has been located, use a dust insecticide. Dusts are more effective, since they are more readily tracked into the colonies by the ants. Also, the use of slow acting insecticides are most useful. They can be carried back to the colony by foraging ants and spread through communal feeding, killing the queen and the young.
- **Carpenter ants** require a more specialized type of control. For effective control, their nests must be located. Carpenter ants do not readily accept bait and residual treatments fail to kill the colonies. *Refer to Chapter 4, "IPM and School Structures."*
- The nests will usually be found outside of the building. These ants will enter buildings where the wood is already damaged in search of food (dead insects, honeydew or other sweet material). They might enter buildings around plugged drain gutters, poorly fitted or damaged siding, wood shingle roofs, leaking roofs and window frames. A typical sign that carpenter ants are present are the characteristically clean tunnels in the wood. Most carpenter ants are active at night; therefore, inspections should be conducted at night for best results in locating the nest.
- The basic control steps to be taken for carpenter ants are to eliminate high moisture conditions and apply pesticides to the nest area. Dusts are very effective since the insecticide is picked up on the ant's legs and body and transported back to the nest. When the nest is located, drill into it and apply the insecticide directly into the nest. Insecticides (dusts and sprays), when used without locating the nest, provide very poor control.

Pear Sawfly, *Caliroa cerasi*, Conifer Sawflies, *Neodiprion spp.*



- Sawflies go through complete metamorphosis. They are not flies but belong to the same order as bees, wasps and ants. They are named for the female's saw-like **ovipositor** (egg-laying appendage).
- Sawflies have two pairs of wings and are dark. They closely resemble wasps. But unlike most wasps, their abdomen is thick and is broadly attached to the thorax. It does not have a thin "waist" like a wasp.
- **Pear Sawfly:**
  - This sawfly is commonly called the pearslug because the larval form resembles a slug. The larvae are dark olive green and are covered with slim. The adults are shiny black with dark wings.
- **Conifer sawflies:**
  - Most of the adults are yellowish-brown to black with yellowish legs. The larvae are yellowish or greenish and develop stripes or spots as they mature. They have six or more prolegs on the abdomen. To distinguish them from caterpillars, look for a lack of prolegs on the first two abdominal segments.

Damage:

- Conifer sawfly larvae cause damage by eating the needles or buds of the tree. This can stunt the plant's growth and, in some cases, kill it.
- The pear sawfly larvae skeletonize leaves of fruit trees and, sometimes, ash and hawthorn. This feeding can stunt the tree growth and affect fruit development.

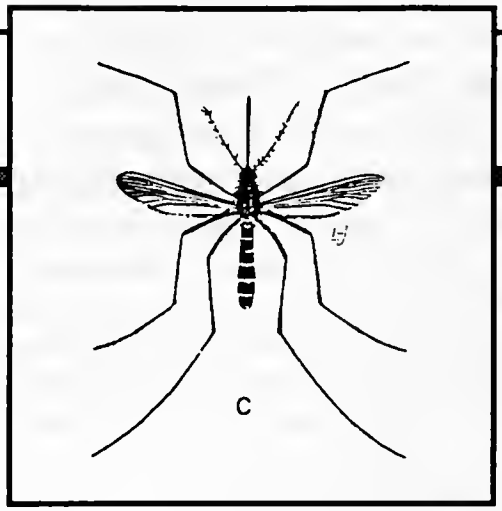
Habitat:

- Conifer sawflies are found feeding on conifers while the pear sawfly is found feeding on fruit trees.

Control:

- Keeping trees and shrubs healthy is the best way to combat sawfly damage. Healthy trees and shrubs will tolerate slight damage. Healthy trees and shrubs also support a population of natural enemies common to the sawflies. Parasitic wasps, birds and small mammals are examples of natural enemies of sawflies.
- Insecticidal soaps, horticultural oils and narrow spectrum insecticides can be used to manage sawfly larvae.
- The pear sawfly can be easily controlled by spraying the trees with a strong stream of water from the hose. The larvae are unable to return to the trees and soon starve to death.

Mosquitos: Aedes spp., Anopheles spp., Culex spp.



- Mosquitoes are slender, delicate flies. They are usually less than 1/4 inch in length. All mosquitoes have long slender legs and a long, sharp proboscis. Mosquitoes go through complete metamorphosis. The eggs are laid on the surface of the water or in a place where they will become wet when it floods. The males have very plumose or feather-like antennae, while the females have very sparse, hairy antennae. Mosquito larvae are aquatic and are often called "wrigglers" because of their habit of wriggling when disturbed.
- Male mosquitos are pollen feeders and do not bite. Female mosquitos must have a blood meal to reproduce and, therefore, bite.
- The different species of mosquitoes that have been listed can be identified from each other by the adult resting position.

Damage:

- Mosquitos are one of the most severe "nuisance" pests.

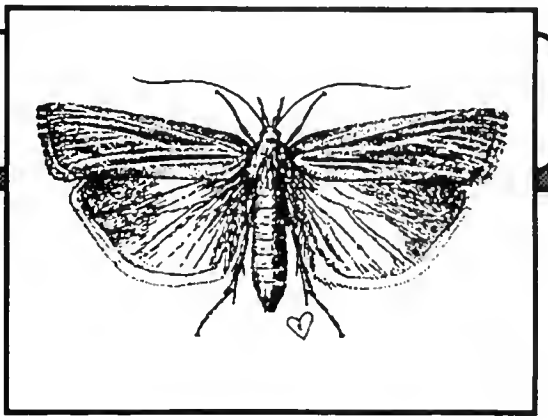
Habitat:

- The larval and pupal stages are completed in the water. Adults can travel substantial distances searching for the blood meal.

Control:

- Mosquito control is most effective when done by communities, the local government, or health departments. There are some things that individuals can do to help reduce the problem.
- Early control is often termed "source reduction." This is the elimination of breeding sites. It includes: 1) removing sources of stagnant water or standing water in cans, tires, trays under plants, etc.; 2) removing vegetation from around water sources, a favorite breeding place for mosquitoes; 3) When sources of stagnant or standing water cannot be eliminated, treat with bacillus thuringiensis israelinsis (BTI) and larvicidal surface oils.
- Screening windows with 16-inch mesh will keep most mosquitoes out of buildings. Repair cracks or tears.

Sod Webworms (Grass moths), *Crambus spp.*



- Sod webworm adults are small, grayish white to beige in color. Their wing span is 3/4 of an inch. When they are resting, the adult's wings are folded close to the body. The head of the adult webworm has a snout like projection in front. These moths are sometimes referred to as "snout moths." If you notice tiny white moths flying erratically for a short distance above the turf, they are probably webworm moths.
- Sod webworm larvae are typical caterpillars. They can vary in color from greenish to beige, brown or gray. Mature larvae will be about 3/4 inch in length. Most will have dark circular spots scattered over their body. This is a good characteristic in identification.

Damage:

- Damage is done by the larvae. They construct tunnels or burrows throughout the turf just at soil surface or slightly below. The larvae line these tunnels with webs of silk like material. This webbing is not placed on the surface of the turf where it can be seen easily. The feeding and damage typically occurs at night. Some of the webworms chew grass blades down to the crown of the plant.
- If flocks of birds are frequently returning to the lawn to feed, there may be a webworm problem. The birds leave many small circular probe holes in the turf. From mid May to October, the grass will turn brown in patches that are about six inches in diameter. The grass should be inspected for the sod webworms throughout the summer season.

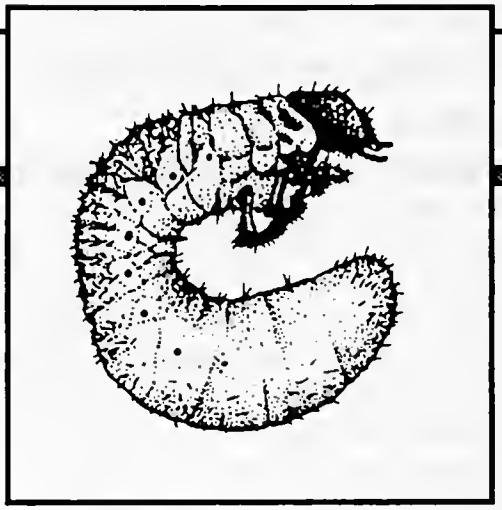
Habitat:

- The larvae live inside their tunnels in the soil. The female moths drop their eggs on the turf as they fly. This typically occurs at dusk. The eggs will hatch in about 7 to 10 days when the average temperature is 78 degrees F. The larvae will feed near the ground on the blades of the grass at night and hide in their tunnels during the day. The total life cycle takes about 6 weeks to complete. In Montana, there are two generations per year. The second generation overwinters in their silk tunnels as mature larvae.
- The adult moths are readily attracted to lights at night. The moths can be seen flying at dusk.

Control:

- Treatments should target the larval stage in the life cycle to be most effective.
- Sod webworms are susceptible to milky spore disease, although it has not been determined how effective this tactic is in Montana's climate. It is sold commercially by many garden centers and through mail order catalogs.
- When you observe a great number of moths while mowing the lawn, keep track of the date. The moths are laying eggs and the young hatch in 2 to 3 weeks. Count the number of larvae present to determine if the larvae population is over the threshold level of 15 larvae per square yard. It is best to mow, water and remove the clippings from the lawn before the application of an insecticide.

White Grubs or May Beetles or June Beetles, *Phyllophaga spp.*



- The adult beetle is 3/4 to 1 3/8 inches in length. They are bulky, shiny, reddish brown to almost black. They go through complete metamorphosis.
- The larvae are white with a brown head and six prominent legs. Larvae are characterized by the "C" shaped position they assume.

Damage:

- The adults will feed on foliage of trees and shrubs. Foliar damage is usually minor.
- The larvae feed on roots of the grass. They cause patches of wilted, dead or dying grass during the spring (April to early June) and then again in the fall (Sept. to late Oct.). In the fall, the grubs will attract skunks, birds and other mammals that feed on them. These animals cause damage to the turf by tearing it up in search of the grubs, which may alert you to the presence of the grubs.

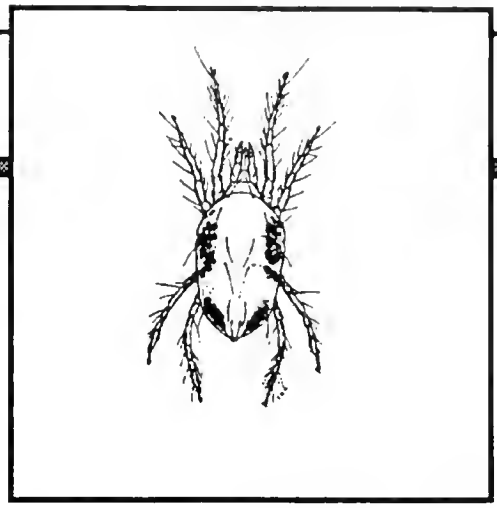
Habitat:

- The larvae are found in the soil, sometimes taking up to three years to mature and pupate.
- The adults will emerge in late spring. The adults make a characteristic buzzing sound when they fly. During spring, the beetles are often attracted to lights at night. They derive their name because adults emerge in mass during the months of May or June.

Control:

- May beetle (June beetle) larvae, known as white grubs, have many natural enemies such as birds, skunks and parasitic wasps and flies. These grubs are also susceptible to a fungus that is part of its natural control.
- Before any type of control measure is taken, determine if the population of larvae is high enough to require any control. At several sites, using a spade, dig a 3-sided flap of turf about six inches deep. Fold the flap back and look for white grubs among the roots. Average the number of grubs; if the average number is five or more, control measures should be considered.
- Soils can be inoculated with spores of *Bacillus popilliae* and *Bacillus lentimorbus* to help reduce grub populations, although the efficacy of this method in the cooler soils of Montana has not been determined.
- If an insecticide is to be used, it is best to wait until the soil temperature has warmed enough to bring the larvae near the surface. Make sure that the chemical goes to the root systems of the turf where larvae are feeding.

Spider Mites, *Tetanychus spp.*, *Eriophyes spp.*



- Mites are not true insects. They go through a simple type of metamorphosis.

- ***Two-spotted spider mite and related species (Tetranychus spp.)*:**
  - Both the immatures and adults are yellowish or greenish, with irregular dark blotches on the sides of their bodies. Adults are less than 1/64 to 1/32 of an inch in length, about the size of a grain of salt. You can easily see them with a hand lens.
- ***Eriophyid mites (Eriophyes spp.)*:**
  - These mites are yellowish to orange. They will appear as yellow to orange felty masses in depressions on the underneath side of leaves. This is the best identifying characteristic.

Damage:

- ***Two-spotted spider mites and other Tetanychus spp.*:**
- These species suck the juices or feed on the soft tissue of the plant and its leaves. Leaves will show a yellowish stippled effect and fade to a bronze color. Eventually the leaves may fall off if infestations are heavy. The plants may also become distorted and covered with webbing. When severely infested, plants may become weakened and die or become susceptible to other problems.
- ***Eriophyid mites and other Eriophyes spp.*:**
- These species of mites cause leaves, and occasionally twigs, to blister or to form galls. On cottonwoods and poplars, these mites can cause warty, woody swellings on the twigs near the buds. Other trees affected are alder, aspen, beech, elm and maple.

Habitat:

- Mites are generally found feeding on the underside of leaves of plants and trees.

Control:

- Plants can tolerate a certain amount of damage without sustaining any adverse damage or harm. If the mite populations become high enough to warrant control, remember it is important to protect beneficial organisms that help control spider mites naturally.
- Avoid using broad spectrum pesticides. These pesticides will often kill off natural predators including predaceous mites. Mite population may be reduced at first when broad spectrum pesticides are used, but in several days, will rebound and surpass pre-application numbers. Use a narrow or target specific miticide, insecticidal soap or horticultural oil. Carbaryl (Sevin) and the pyrethroids, although labelled for mites, actually worsen infestations and are two broad-spectrum pesticides you may want to avoid.

- Weak or distressed plants are more readily attacked by mites. Proper maintenance of plants and trees can help avoid an outbreak. Provide plants and trees with adequate irrigation and proper nutrients. When plants are drought-stressed, mite populations can build up very quickly. High nitrogen levels will favor some mites, therefore, do not apply more than soil tests indicate is needed.
- Pruning branch tips and damaged portions of the tree or plant can be effective in reducing mite populations.
- Sulfur works well to reduce some mite populations, but the dust will disrupt the predaceous mites.
- Insect growth regulators, such as the avermectins (Avid), appear to work best for mite control. They can be applied topically or as tree injections that carry the product to portions beyond reach.

Chapter Seven

Vertebrate Pests and Their Control

The principles of IPM work well to manage vertebrate pests that occur in schools and other buildings and usually result in more effective and longer term control than when using vertebrate pesticides alone. The animals must be correctly identified so that effective control practices are implemented. Habitat, particularly sources of food, rest and nest sites and access points into buildings, should be modified to remove food, water and/or shelter for the pest animal. The school environment should be regularly monitored for the presence and number of vertebrate pests. Before initiating control measures, be certain that some action is necessary.

House Mice

The house mouse (*Mus Musculus*) is a small, slender, dusty-gray rodent with a slightly pointed nose, small, black protruding eyes, large, scantly haired ears, and a near hairless tail with obvious scale rings. House mice are considered among the most troublesome and economically important rodents in the United States. They are commonly found and readily adapt to life in buildings. They are probably the most common mammal in cities next to people.

Habitat. House mice live in and around homes, farms and commercial and institutional establishments as well as in open fields and agricultural lands. Once house mice establish themselves in a suitable building they generally become full time residents. In temperate regions the onset of the cold weather each fall causes deer mice to move into structures in search of shelter and food. Deer mice are usually a temporary nuisance, although they may build nests and raise young. Deer mice can be trapped out fairly easily. House mice can increase in number rapidly and spread throughout a building quickly. Therefore, early detection and correct identification is important.

Food Habits. House mice eat many types of food but prefer seeds and grain. They do not hesitate to sample new foods. Most are "nibblers," sampling many kinds of items that exist in their environment. Foods high in fat, protein, or sugar may be preferred even when grain and seeds are also present. Such items include bacon, chocolate candies, peanut butter, butter and nutmeats. Mice can get by with little or no free water, although they readily drink when it is available. Mice obtain most of their water needs from the food they eat.

House mice consume and contaminate food stuffs and animal feed. A single mouse eats only about 10g (grams) of food per day (8 lb/year), but because of their habit of nibbling on many foods and discarding partially eaten items, mice destroy considerably more food than they consume.

House mice cause structural damage to buildings by their gnawing and nest building activities. In buildings they may cause extensive damage to insulation inside walls and ceilings. House mice often make nests in large electrical appliances, where they may chew up wiring as well as insulation resulting in short-circuits, possible fires, or other malfunctions that are expensive to repair. Mice often damage stored items in areas such as basements, storage closets, food pantries, science labs and libraries.

General Biology, Reproduction and Behavior. House mice are mainly nocturnal. Mice detected during daylight hours often indicates a high population is present.

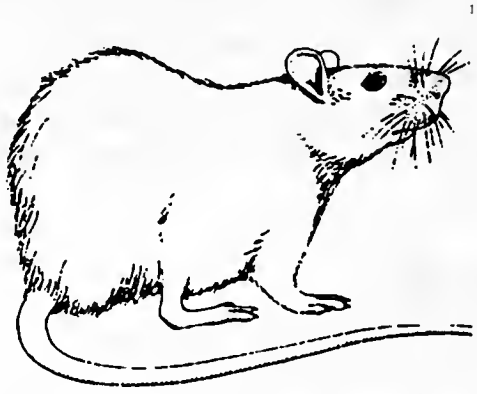
Mice have poor eyesight and rely more on their hearing and their excellent senses of smell, taste and touch. They are considered color-blind. Therefore, for safety reasons, rodenticide baits can be dyed distinctive colors without causing avoidance by mice as long as the dye does not have an objectionable taste or odor.

House mice can dig and may burrow into the ground around structures when other shelter is not readily available. Nesting may occur underground or in any sheltered location. Nests are constructed of shredded fibrous materials such as paper, burlap, rags, bark, or similar items and generally have an appearance of a ball of material loosely woven together.

Litters of five to six young are born 19 to 21 days after mating, although females who conceive while still nursing may have a slightly longer gestation period. Newborn mice are naked and their eyes are closed. They grow rapidly; within two weeks they have hair and their eyes are open. They begin to make short excursions from the nest and eat solid food at three weeks. Weaning soon follows and mice are sexually mature when six to 10 weeks old. House mice may breed year round, but when they are living outdoors, they are usually most actively reproducing in spring and fall. The female may have five to ten litters per year, allowing populations to grow rapidly under good conditions. Breeding and survival of the young slow down greatly when population densities become high.

House mice have physical capabilities that enable them to gain entry to structures by gnawing, climbing, jumping, swimming and other tactics.

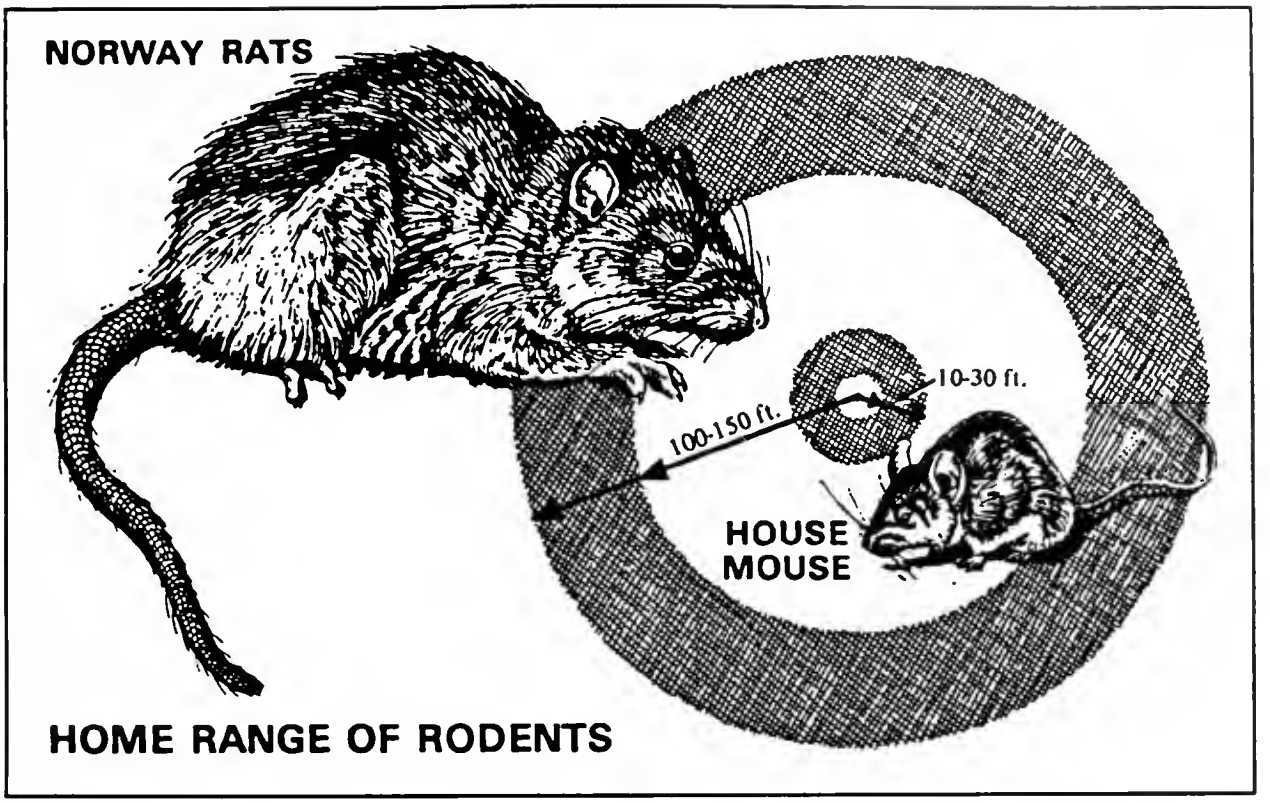
Rats



The only domestic rat species that is found in Montana is the Norway rat (*Rattus norvegicus*). Like the house mouse, the Norway rat was unintentionally introduced into North America by settlers who arrived on ships from Europe. The Norway rat is most likely to be found in eastern Montana where it may occur around open dumps, feed lots and grain storage. Occurrence in schools is rare.

The Norway rat has a blunt muzzle, short ears, small eyes and adults average about one pound. Its fur is coarse and usually brownish to reddish gray above and whitish gray on the belly. It has several color phases, but those in Montana tend to be black or slate gray.

Habitat. Rats live in close association with people. Depending on the species, they burrow or climb to make nests in buildings and structures, beneath concrete slabs, along stream banks, in trees around ponds and garbage dumps and other locations where suitable water, food and shelter are present.



HOME RANGE OF RODENTS

On farms, they may inhabit barns, granaries, livestock buildings and kennels. In urban or suburban areas, they live in and around residences, cellars, warehouses, stores, slaughter houses and sewers. Although they can climb, Norway rats tend to inhabit the lower floors of multistory buildings.

General Biology. Rats are naked and their eyes are closed when they are born about 21-23 days after conception. Litters have five to eight young and they develop rapidly, growing hair within a week. When they are 9 to 14 days old, their eyes open and they begin to explore for food and move about near their nest. In the third week, they begin to take solid food.

Young rats generally stay in their nest and can't be trapped until they are about one month old. At about three months of age, they are completely independent of the mother and are reproductively mature. Rats can breed at any time of the year and, in Montana, may produce four to six litters per year. Most breeding occurs during the warmer months between spring and fall. Norway rats usually select a nest site in an underground burrow.

Rats have a keen sense of hearing which can help them detect and escape danger. They also communicate with sounds, many of which are in the high frequency range.

When necessary, rats will travel considerable distances for food. They can sometimes be seen at night running along overhead utility lines. This is important from the standpoint of control, because additional baiting or trapping on the ground or floor may intercept very few rats. Some rats are very wary and will move elsewhere if severely and frequently disturbed. Rats see poorly, relying more on smell, taste and hearing. They are considered to be colorblind. They respond only to degrees of lightness and darkness of colors.

Feeding Behavior. Rats will eat nearly any type of food. When given a choice, they select a nutritionally balanced diet, choosing fresh items over stale or contaminated foods. Rats require 1/2 to one ounce of water daily when feeding on dry foods, but need less when moist foods are available. Food items in kitchen garbage offer a fairly balanced diet and also satisfy their moisture needs.

Rats usually begin searching for food shortly after sunset. If the food is in an exposed area and too large to be eaten quickly but not too large to be moved, they will usually carry it to a hiding place before eating it. Many rats will hoard considerable amounts of solid food, which they may or may not eat later. Rats as well as other rodents are sometimes observed gnawing on wood and other materials. Gnawing is necessary to keep their incisors, which grow throughout the lifespan, worn down.

They use a keen sense of smell to locate food items and, apparently, to recognize other rats, especially those of the opposite sex. Taste perception of rats is good. Once they have tasted food, taste probably overshadows or overrides the effect of the odor of that material. An important sensory factor with rats is touch. The long, sensitive whiskers near their nose and the guard hairs on their body are used as tactile sensors. The whiskers and guard hairs enable the animal to travel in the dark adjacent to walls (which they prefer) and in burrows.

Damage. In warehouses, they gnaw into stored or packaged foods. They often live in attics or in the spaces between floors. They may gnaw on electrical wires and tear up insulation for nesting. In outdoors, they often live in overgrown landscaped areas, feeding on ornamentals, vegetation, fruits and nuts. In some situations, pet food, bird seed and garbage may be major food sources.

Rodent-Borne Disease

House mice and rats are implicated in the spread of a number of diseases, either directly, by contamination of human food with their urine or feces, or indirectly, by way of rodent fleas and mites. Listed below are several rodent borne diseases.

Disease	Transmission
Lymphocytic Chorlmeningitis	Contaminated food, dust from droppings
Salmonellosis	Contaminated food
Bubonic plague	Infested fleas
Rickettsial pox	House mouse mite
Ratbite fever	Bites
Tapeworms	Droppings, contaminated food
Ringworm	Direct contact, mites
Dermatitis	Bites
Infection jaundice	Contaminated food, water, etc.
Hanta virus	

Control of Rodents in Structures

Remember, there are never-ending external sources of rodents. If some "pest-proofing" features are not implemented in school buildings, mouse and rat control efforts such as poisoning and trapping will be required continuously. Initial efforts and expense to prevent problems will save time and labor in the long run.

Exclusion

To prevent rodent entry, their capabilities must be understood. For example, they can;

1) run along or climb electrical wires, ropes, cables, climb shrubs and trees to gain entry to a building,
2) climb almost any rough vertical surfaces such as wood, brick, concrete and weatherized sheet metal,
3) crawl horizontally along pipes, augers, conveyors, or conduit, and
4) gnaw through a wide variety of materials including lead, aluminum sheeting, wood, rubber, vinyl and concrete blocks.

Keep in mind that rats and mice can enter holes that are surprisingly small. House mice, for example, can gain entrance through openings only 1/4 inch high. They often enter buildings under and around doors that do not seal tightly.

Holes and Openings. To prevent rodent entry, seal all holes with materials resistant to

rodent gnawing such as concrete mortar, galvanized sheet metal or heavy gauge hardware cloth. Smaller holes and cracks can be sealed with steel wool mixed with caulking.

Vents and Windows. Screen ventilation openings and windows with galvanized hardware cloth for larger openings or where the screen may be subjected to abuse, add crossbars to support the hardware cloth. If an opening is in an access way, install the screen in a hinged frame.

Exterior Doors. Doors should fit tightly with the distance between the door and frame less than 1/4 inch. In some instances, it is possible to build up the threshold rather than modify the door. Install flashing or metal channel on the lower edge of doors, particularly softwood doors. Properly applied flashing extends to within 1/8 inch of the edge, sides and bottom of the door.

Foundation and Floors. Gaps or flaws may exist along building exteriors where the wall framing or siding meets the foundation. These structural flaws provide an easy entry for the rodents. Rodents often gain entry into buildings that have crawl spaces through poor fitting or missing crawl doors or damaged or missing vent screens.

Drains and Pipes. Rodents may use drainage pipes or sewage systems as routes to enter buildings. Use floor drains with metal grates held firmly in place. Grate openings should be less than 1/4 inch.

Mice and rats may enter buildings through sewer pipes accessed through manholes, catch basins, broken pipes, or drains. Mice and rats are excellent swimmers and water traps do not impede their movements. The problem of mice and rats in sewers is usually greatest in places where sanitary sewers are interconnected with storm sewers, thus, providing multientry points. The domestic sewer of an average community provides enough food to sustain a large number of mice and rats. This problem has increased as a result of more garbage disposal units being installed in homes and institutions.

Mechanical Guards. To prevent rodents from climbing or traveling along a particular route, install guards of sheet metal or similar materials. Guards must be wide enough and positioned to keep rodents from reaching their outer margins by climbing or jumping.

Sheet metal bands attached to a wall or cones and disks on ropes and cables will prevent climbing by rodents. Rodent guards should be at least 12 inches wide. Inside buildings, such guards can prevent rats and mice from climbing at corners. Guards also can be installed to prevent rodents from climbing the outside of buildings having rough exterior walls. By using a combination of hardware cloth or other suitable material, buildings can be made rodent proof.

Habitat Modification

Sanitation. Poor sanitation is one reason for moderate to high rodent populations in urban and suburban areas. Even the best efforts at good sanitation may not completely eliminate rodent populations, but it can often prevent rodents from flourishing in large numbers.

Sanitation involves good housekeeping and includes proper storage and handling of food materials, feed, and edible garbage. Store bulk foods in rodent proof containers or rooms. Place sacked or boxed foods in orderly rows on pallets in order to allow thorough inspection. Keep materials away from walls in storage areas. Painting a 12 inch wide white band on the floor adjacent to the wall will aid in detecting rodent droppings and other signs. Sweep the floors frequently to permit ready detection of fresh rodent signs.

Food for laboratory animals can be an excellent source of food for mice in schools. Keep all feed materials stored in metal rodent proof containers. Keep laboratory areas clean of spilled feed. If possible, keep all animal cages in rodent proof rooms.

Kitchen waste and trash in lounges and snack areas that provide a food source should be properly stored and frequently removed for disposal. Proper refuse storage containers are heavy-duty, damage resistant and equipped with tight fitting lids. Racks or stands prevent corrosion or puncture of containers. Remove mouse shelters under containers and minimize the chance of the containers being overturned. Refuse should be collected regularly and before refuse storage containers become overfilled.

Elimination of Harborage. Regular removal of debris and control of vegetation around structures will reduce the amount of shelter available to rodents. The periphery of buildings and structures kept clean of vegetation and debris will discourage mice activity and will allow easier detection of mice sign.

Electronic noise or "field" emitters

Rodents are wary animals and can be frightened by unfamiliar sounds or sounds coming from new locations. However, most rodents quickly become accustomed to these new sounds, especially when they are heard repeatedly.

Numerous devices that produce "ultrasonic" sounds or "electric fields" or "magnetic fields" that claim to control rodents are ineffective.

Trapping

Trapping is an effective method of controlling rodents. However, trapping requires knowledge of proper placement and the methods of monitoring traps. Trapping is recommended as a supplement to exclusion and sanitation methods. It is the preferred method for identifying the rodent species and controlling of low level infestations.

Trapping has several advantages; 1) it does not rely on inherently hazardous rodenticides, 2) it permits users to gauge success, and, 3) it allows for disposal of the rodent carcasses, thereby eliminating odor and additional problems resulting from decomposing carcasses of poisoned rodents.

Simple to operate, inexpensive, wood based snap traps are available in most hardware and farm supply stores. Traps baited with peanut butter mixed with a small portion of bacon drippings works well. A variety of other baits such as nutmeats, dried fruit, bacon, marshmallow or peanut butter mixed with rolled oats also work well. Use only fresh bait. Baits that become stale, lose their effectiveness. Set traps close to walls, behind objects, in dark corners and in places where rodent activity is seen. Place the traps with the trigger end pressed against the wall so when rodents follow their natural course of travel (usually close to a wall), they will pass directly over the trigger. Set traps so that the trigger is sensitive and will spring easily.

Use enough traps to make the campaign short and decisive. Leaving traps unset until the bait has been taken at least once reduces the chances of the rodents escaping the trap and becoming trap-shy.

Multiple-capture mouse traps, that are operated by a spring mechanism or one-way doors, are an effective alternative to snap traps. Other kinds of traps are also effective in catching rodents.

Keep traps reasonably clean and in good working condition. When dirty, clean them in a hot detergent solution with a stiff brush. Human and dead rodent odors on traps are not known to reduce trapping success.

An alternative to snap traps or live traps are "glue boards" which catch and hold the rodents attempting to cross them in much the same way flypaper catches flies. Place glue boards wherever rodents travel—along walls or in established

pathways. Don't use glue boards where people, pets, or desirable wildlife can contact them. Glue boards lose their effectiveness in dusty areas unless enclosed in a bait box.

Temperature extremes and moisture may affect the tackiness of some glues. Ready-to-use glue boards may be purchased, or you may buy the glue to make your own boards or traps. Dispose of live, trapped rodents by submerging the glue board in water to drown the animal. A sharp blow to the base of the skull will also kill the animals. If pets or children become entangled in the glue, the glue board may be removed by applying cooking oils or soap and water to dissolve the glue substance.

Poisons

Use of rodenticides in a school environment, using an IPM approach, should not be the initial choice for rodent control. In most cases, a combination of exclusion, habitat modification and trapping should be implemented first. Use of rodenticides may be appropriate for a quick "knockdown" of high populations or in difficult to access areas where traps and exclusion is not practical. In any case, rodenticide baits should be placed only in places inaccessible to students and staff.

Rodenticides can be classified into two groups, single dose (acute) poisons and multiple dose (chronic) poisons.

Acute (single dose). Single dose acute rodenticides will give a quick knockdown of a rodent population and are often used in situations where high numbers of rodents need to be controlled quickly. They are generally more economical than chronic rodenticides and often require less labor to gain good control.

The most commonly used acute rodenticide is zinc phosphide. It has a taste and odor which is aversive and may result in poor acceptance of the bait by rodents. Some rodents may consume a sublethal dose and survive. This sometimes results in the survivors associating the taste or odor of the zinc phosphide with being sick and avoiding further consumption of the bait. When this happens, the rodents are referred to as bait shy and further attempts to use zinc phosphide are often unsuccessful.

Prebaiting increases the acceptance of zinc phosphide baits. The prebait, a nontoxic bait similar to the poison bait, is applied before use of zinc phosphide bait. This increases acceptance and consumption of the zinc phosphide bait resulting in better control. It is not recommended that zinc phosphide bait be used without prebaiting.

There are few situations where an acute rodenticide should be used in a school environment.

Chronic (multiple dose). Chronic rodenticides are, for the most part, anticoagulants. They require repeat feeding over several days to be effective. Repeated ingestion results in the blood losing its clotting ability and death occurs 4 to 10 days after the first ingestion of the bait. Bait should be applied in bait boxes or stations and a continuous supply must be maintained until control is achieved. Anticoagulants have no aversive taste or odor and are not known to cause bait shyness.

Consumption of bait often continues after the onset of poisoning symptoms and results in the rodent consuming more than a lethal dose. This may result in dead or dying rodents containing anticoagulant residues in sufficient quantity to present a non-target hazard to animals eating these rodents. This is particularly true of the more toxic single dose anticoagulants (brodificoum and bromadiolone). Removal of carcasses and blocking access to treated areas is an important part of managing rodenticide hazards. In the case of accidental ingestion of anticoagulants by humans or pets, vitamin "K" and/or blood transfusions are effective corrective treatments. These antidotal treatments, as well as

the toxicant's slow action, give anticoagulant bait a fairly wide margin of safety.

Anticoagulant Resistance. Within any population of rodents, some individuals may be resistant or highly tolerant to the effects of anticoagulants. Over time, these individuals pass on their characteristics to their offspring creating a population resistant to anticoagulants. This problem can generally be prevented by using anticoagulants infrequently or periodically alternating to a different class of rodenticide.

Reasons Anticoagulant Baits May Fail. Anticoagulant resistance is only one reason that failure to control rodents may occur when using anticoagulant baits.

Failure to achieve control with anticoagulant baits that are "poorly accepted" may be because of one or more of the following reasons:

1. The bait used is a poor choice or is formulated improperly; other foods are more attractive to rodents.

2. Insufficient bait is made available, and none remains from one baiting to the next.

3. Too few bait stations are used; some are too far apart. In some situations, stations may have to be within five to 50 feet of one another, especially for mice.

4. The control program does not cover a large enough area, permitting rodents to move in from untreated adjacent areas.

5. Other foods for rodents are abundant.

6. The bait has become moldy, rancid, insect infested, or contaminated with other materials that reduce acceptance. Periodically dispose of old bait and replace it with fresh material.

Other Chronic Rodenticides. Some other rodenticides that generally require multiple feedings from bait boxes to be effective include:

1. Alpha-Cholorhydrin - toxic at high doses and a male sterilant at low doses.

2. Bromethalin - affects the cellular energy cycle and may be effective with single feeding.

3. Cholecalciferol (Vitamin D3)- causes death after repeated doses.

Tracking powders are toxicants mixed with dust. The toxic powder adheres to the rodent's feet and fur and is consumed during grooming. Powders are particularly useful for house mice control, although they are also used for rat control. Several of the anticoagulant rodenticides are registered for rodent control. Zinc phosphide is also registered as a tracking powder for rodent control.

Place tracking powders in the areas where the animals are more likely to be; along runways, in walls and behind boxes. Tracking powders must be used carefully to avoid food contamination and prevent the dust from becoming airborne.

Field Rodents

Field rodents include ground squirrels (often called gophers), pocket gophers (often called moles), field mice or voles, tree squirrels and porcupines. At times, any of these animals may occupy school grounds and cause damage. Ground squirrels may occupy sport fields where their burrow openings present a hazard to students and staff. Burrows may be established near building foundations or around desirable landscaping. Pocket gophers and field mice may forage on landscape plants and lawns causing extensive damage.

Generally, the use of poison baits is not recommended in urban areas unless access to the treated areas can be controlled. Pets and children can be at risk of injury if they come in contact with baits or poisoned carcasses.

In school situations, control options should be limited to habitat modification, trapping or burrow fumigants. School pest managers are encouraged to contact the Montana Department of Agriculture before implementing field rodent control actions. The Department has a number of publications on management of field rodents and can provide advice and assistance on field rodent problems.

Bats

Identification

Bats are the only mammals that truly fly. Their ability to fly and their nocturnal habits have contributed to bat folklore, superstition and fear. Bats, in most situations, are beneficial to humans because they consume large numbers of insects such as mosquitos each night. They are not aggressive and usually will not attack or bite unless provoked. Bat populations in the US are declining, largely because of habitat disturbance. Efforts are needed to conserve bats whenever possible.

The little brown bat (*Myotis lucifugus*) is the most common bat in Montana and is the species most commonly found to occupy structures. The little brown bat will colonize buildings using them as roosts and a place to rear young. Other colonial species found in Montana include the big brown bat, Townsend's big-eared bat and the Yuma bat. In addition, solitary bats such as the hoary bat and the silver-haired bat are also found in Montana.

General Biology, Reproduction and Behavior

Bats spend the day in secluded retreats and begin feeding toward evening. After leaving their roost to feed, bats usually fly to a water source to drink. Bats that occur in Montana are insectivorous, feeding on small flying insects, including some which are harmful or a nuisance to humans. Some bats may consume several thousand insects each night. Bats are able to avoid obstacles and capture insect prey using echo location by emitting high frequency sounds.

Bats mate in the fall. The female retains sperm in the uterus until spring when ovulation occurs and fertilization takes place. Pregnant females congregate in maternity colonies in caves, mines, buildings, or other dark retreats. No nests are built. Birth occurs from May through July. Most species produce a single young. Some have twins and a few species have litters of three or four. Young bats grow and are able to fly within three weeks. The nursery colonies disperse after weaning in July and August.

Bats prepare for hibernation around the time of the first frost. Although some bats species may occupy buildings in summer, they generally migrate to caves to hibernate. Some species migrate relatively short distances while others may travel several hundred miles. Bats may occasionally hibernate in structures if they have access to protected areas where the temperature is above freezing. Bats in Montana hibernate from September to April or May.

Damage and Damage Identification

Bats may become a nuisance in buildings by their squeaking, scratching, scrambling, and crawling in attics, walls and chimneys. Bats may reveal their presence by fecal droppings and stains near eaves and by their entrance holes below roofs.

Inside Buildings. It is not uncommon to discover one or two bats in a building. The little brown bat accounts for most sudden appearances. Common in urban areas, bats often enter buildings through open windows, unscreened vents, crevices between the outer wall and vents, cracks around a window, or through holes in

loose boards or bricks.

A bat usually will find a way out by detecting the movement of fresh air. The simplest solution for removing the bat is to open all windows and doors leading outside. If the bat is still present by nightfall, lights should be turned off to help the bats find open doors or windows. If the lights are turned on, the bat may hide behind drapes, curtains and pictures. Bats normally will not attack people, even when chased. If the bat refuses to leave, it can be caught in a net, small box or can, or a gloved hand and released outside.

Most bats are able to squeeze through tiny openings. Entry into buildings by smaller species requires an opening no wider than 3/8 inch.

Outside Buildings. Bats may temporarily roost behind shutters, under wood shingles, roofing, drain gutters, awnings, overhead trim flashing, patios and breezeways. Bats often fly around open water or ponds to drink or catch insects. Street and exterior building lights may attract flying insects which in turn attract bats.

Health Hazards

Rabies. Rabies is the most important public health hazard associated with bats. Although most bats are healthy, a few, perhaps 0.5% of a population, may carry the rabies virus. Bats affected by rabies are seldom aggressive but tend to appear sick and lethargic. Bats found during the day on the ground should be suspect. To be safe, bat bites should always be considered as potential rabies exposures. Immediate and thorough washing of all bite wounds and scratches with soap and water followed by prompt medical attention is essential for treatment of any bat bite.

Never touch a bat with bare hands. Bats should be picked up with gloves, forceps, or a shovel. If the bat has bitten a person or a pet, the bat should be captured without destroying the head, placed in a container, and shipped under refrigeration to the Montana Department of Livestock Diagnostic Laboratory, Montana State University, Bozeman, MT 59717. Do not freeze the sample unless there is no other option. For convenience, the sample may be submitted through a local veterinarian.

Histoplasmosis. Histoplasmosis is an airborne disease caused by a microscopic soil fungus that affects the lungs of humans. The fungus is often found in accumulations of bird and bat droppings. There is a potential risk of infection to anyone removing bat feces. Respirators approved for nuisance dust provide some protection. Dried feces (guano) should first be dampened with water before it is removed to further reduce the hazard of dust inhalation.

Damage Prevention and Control Methods

Exclusion. Excluding bats from buildings is the most effective, long-term solution to prevent bats from occupying buildings. In old frame buildings, openings occur where wood has warped, shrunk, or decayed. Other entry points are under loose flashing, eaves, cornices, louver space under corrugated roofing, spaces under doors and around windows and openings where electrical outlet boxes and water pipes enter the building.

Bats should be out of the building before bat proofing begins. Bats sealed inside the building will die and create an odor problem and possibly attract other pests. Bat proofing is best done in the fall after the bats have left the building to hibernate.

If bat proofing is done while bats are still present, seal all openings except the main access. For several days, bat counts should be made as they leave the main exit. On the evening that the exit is to be blocked permanently, seal the access when all the bats have left. If the colony is a nursing colony, do not seal the accesses until the young are independent of the adults. Repeat this routine if any bats remain inside.

Repellents. Napthalene crystals or flakes (moth balls and moth repellants) are the only chemicals registered by the US Environmental Protection Agency for indoor bat roosts. They should be spread on the floor or applied between walls. Sometimes, the repellent may be placed in a loose mesh cloth bag and suspended from the rafters. About 5 pounds of repellent for every 2,000 cubic feet of space will treat an average attic. As the chemical vaporizes, bats may be repelled. Dosages of 10 pounds per 2,000 cubic feet may dislodge bats in broad daylight. Bats will return when the odor dissipates. Vapors from napthalene crystals are toxic.

Illumination can be an effective repellent. Floodlights strung through the attic to illuminate all roosting sites may cause bats to leave. Large attics may require four or more 100 watt bulbs, but a 150 watt spotlight is more effective. Fluorescent bulbs may also be used.

Drafts have successfully repelled bats in areas where it is possible to open doors and windows to create strong breeze with an electric fan.

Contact Repellents, such as sticky type bird repellents and rodent glue boards, have been used successfully in situations where roost surfaces and bat accesses may be coated. These have to be replenished from time to time since dust causes them to lose their stickiness.

Toxicants. Currently, no pesticide is registered for lethal control of bats in Montana.

Other Methods. Artificial roosts, if properly constructed and located, will sometimes attract bats that are displaced or excluded from a structure.

Skunks

Skunks occupy open lands, forest edges and riparian areas. They often enter the edges of urban and suburban environments as well as school grounds bordering these kinds of habitats. They are often attracted to human environments by pet food and garbage and attractive harborage such as wood piles, junk piles, idle vehicles and open foundations under structures. Skunks should not be destroyed needlessly. They are largely beneficial because they eat mice and pest insects. However, their presence around human habitation should be discouraged.

The presence of skunks can often be prevented by good sanitation. Place all garbage in covered, skunk-proof containers and dispose of the garbage frequently. Do not use plastic or paper bags to store garbage. Skunks can easily tear them apart. Clean up wood piles and junk piles and keep grass mowed short. This will discourage skunks from living in these sites and discourage the presence of mice which skunks hunt for food. Block or screen off access to space under buildings.

If skunks still frequent the school grounds, live trapping is an effective method for removing them. Skunks are nocturnal so trapping should be done at night. Set the trap where the skunks are known to travel or where they have been seen.

Two types of livetraps are available. One is solid metal trap with a mesh trap-door. The other type is a wire mesh trap. With the solid metal trap there is less chance of being bitten when handling a trapped skunk and the skunk is less likely to spray while confined. If a mesh trap is used, be sure to place a cover, such as a gunny sack or piece of canvas, over the trap before it is set so it can be approached once a skunk is trapped. With mesh traps, extra care must be taken to keep from being bitten or sprayed. Do not operate the traps during the day unless someone can monitor the trap. Do not place the trap where it will be exposed to the sun. A

trapped animal may die from heat stress. Keep dogs and cats away from traps to prevent them from being trapped or harassing a trapped skunk.

Decide the fate of the skunk before trapping is begun. Skunks can be moved and released from livetraps. However, this often only transfers a problem somewhere else. The skunk, released in a new and unfamiliar habitat, may not survive. Killing the trapped skunk in often the most humane option. Drowning the skunk by submersion or filling a solid trap with water is an effective way of destroying the skunk.

Skunks are a common vector for rabies. Every skunk should be approached and handled keeping the presence of rabies in mind. The solid metal trap will prevent the trapper from being bitten. Do not place your fingers around the trap door. Drowning the skunk in the trap rather than releasing it will reduce the risk of possible exposure to rabies.

A healthy skunk will generally ignore or avoid humans. Normal defensive behavior includes arching the tail over the back, stamping of the front feet and directing the anal scent glands at the intruder. A rabid skunk is strictly on the offensive. It may charge head first with the tail down or dragging on the ground. In the later stages of rabies, a skunk often drags or has poor control of its hindquarters. If a skunk is suspected of being rabid, contact the local health authorities.

Birds

Bird control can present special problems because most species are protected by federal and state laws. Also, many people oppose harming birds. Any bird control program must be planned carefully, so that no laws are violated and the public understands the need for the action. Where bird roosting or feeding endangers human health or causes economic damage, a bird control program can be justified. Pigeons, house sparrows and starlings are the most common bird pests in Montana. Pigeons, house sparrows and starlings are not protected in Montana.

Pigeons nest on the tops of beams and ledges commonly found in older buildings. House sparrows and starlings are cavity nesters although house sparrows sometimes nest on protected ledges. The droppings from these birds may carry diseases, damage plants, corrode concrete and deface structures. After birds vacate nests, bird mite and louse parasites can move indoors, becoming a problem for humans.

Woodpeckers, especially flickers, have the habit of drumming on buildings to establish territories and occasionally to build cavity nests. A building, depending on its construction, can sustain considerable damage from the drumming and excavation activities of woodpeckers. Woodpeckers are federally protected and cannot be killed unless a federal permit is obtained.

Damage Prevention and Control

Methods of bird control include; 1) exclusion, 2) repellents, 3) live trapping and nest destruction, and 4) toxicants.

Exclusion. Exclusion and habitat modification, over the long term, are the best and most effective control techniques for bird control in terms of cost and results.

Exclusion involves sealing or screening cavities or ledges on structures to prevent birds from nesting or roosting. Older buildings with ornate architecture often require this approach.

Wire strips with many sharp pointed wires, such as Nixalite, Cat Claw or porcupine wires are available and can help keep birds off some areas.

Where birds are a problem inside buildings or other structures, close all openings so they cannot enter. This is a permanent solution to problems inside the structure.

Where birds are roosting on a ledge of a building, place a board or metal covering over the ledge at a 45-degree angle to prevent roosting

on the ledge.

Nylon or plastic bird netting is another option for exclusion. Birds roosting inside open buildings can be excluded from the roost by covering the underside of the rafters with netting. The netting prevents the birds' access to rafters where they perch.

Heavy strips of polyvinyl chloride (PVC) plastic hung in doorways that must be kept open because of frequent traffic, may be useful to exclude birds from some areas.

Repellents. Various nontoxic chemical repellents are available in the form of liquids, aerosols, nondrying films and pastes. These materials make birds uncomfortable when they land on them and force them to look elsewhere for roosting sites. To be effective, all roosting and/or resting surfaces in a problem area must be treated, or the birds will just move a short distance to an untreated surface.

Applications should be made about 1/2 inch (thick in rows spaced no farther apart than 3 to 4 inches. Birds should not be able to land between the rows without contacting the repellent.

When applied to building surfaces, the surface should first be cleaned and then strips of adhesive tape applied. Apply the sticky paste on top of the tape. Otherwise materials may be difficult to remove or may stain the building.

The effectiveness of these repellents is usually lost over time, especially in dusty areas. In most cases these materials will repel pigeons for only about one year before another application is necessary.

Scaring Devices. Scare devices include loud noises, ultrasonic devices, hanging mylar strips or other waving colored flags, balloons and snakes, owl and hawk effigies or models. Any effect these devices might have is almost always temporary. The birds become accustomed to these disturbances quickly, especially when there is no negative consequence from the device's presence.

Use of scare devices should be integrated with other control methods and activities that the birds view as negative and that are associated with scare devices.

Other scare devices include exploding shotgun shells (Cracker Shells), gas exploders and shooting campaigns. These techniques are seldom acceptable and are often illegal in areas where schools are located.

Trapping and Nest Destruction. Trapping and removing birds can be a successful method of control at locations where birds feed or rest. Several trap designs are available that can be built and others are available for purchase. Trapping requires a dedicated effort over several weeks. Trapping campaigns will need to be repeated periodically as populations rebuild. Euthanasia of trapped birds is almost always necessary. Birds, especially pigeons, released even many miles from the capture site are likely to return.

Nest Destruction. Destroying nests as they are built can be helpful in reducing bird numbers. This technique should be used in conjunction with other control methods. It is illegal to destroy nests of migratory birds, so this effort must be made before nests are constructed.

Toxicants. Several chemical compounds are available for bird control. These chemicals can be hazardous to humans, domestic animals and wildlife. Read the labels carefully and take precautions not to expose the materials where children, pets or livestock or nontarget wildlife are likely to encounter them. Whenever target birds are found dead, dispose of the carcasses. Effective bird control requires careful attention to application techniques and an understanding of bird behavior. Applicators are advised to contact a Montana Department of Agriculture Vertebrate Pest Specialist before proceeding with chemical bird control operations.

Chapter Eight
Weeds and Their Control

Generally, any plant that is growing where it is not wanted is considered a weed. Weeds in the school environment spoil the beauty of the turf and landscape. Some can also cause skin irritations, aggravate allergies and cause hay fever. Some weeds are poisonous and others harbor insect, mite, vertebrate and plant disease pests. Noxious weeds are certain legally defined weeds that must be controlled under state statute.

Weeds can cause problems in and around schools in ornamental plantings, on the playing field, in bare ground play areas, on turf areas, in vacant lots and close to buildings where they can harbor pests. All of these sites should be considered when developing a management plan for the school.

Management Strategies For Weeds

Effective weed management begins with the understanding of goals for use of the landscape. More control may be needed on school playgrounds than on the lawn around the school. Control of weeds in ornamental plantings may be less critical than control of weeds around buildings that harbor vertebrate pests. A well designed management program will determine the order of priorities.

In addition, a well designed management plan should consider all control options, including proper turf and ornamental plant care and management.

Prevention is the most effective and economical weed control strategy available to the school manager. Making conditions of growth more beneficial for turfgrasses and ornamentals than for weeds will reduce the chances of weed infestation. It is extremely important to use varieties of plants that are adapted for the area when designing the school yard. Using weed free seed when planting can also be an excellent prevention tool.

Cultural and mechanical controls are effective tools in the school landscape maintenance as well. These may include mowing, hand pulling, hoeing, tillage, mulching, plant competition and plant rotation.

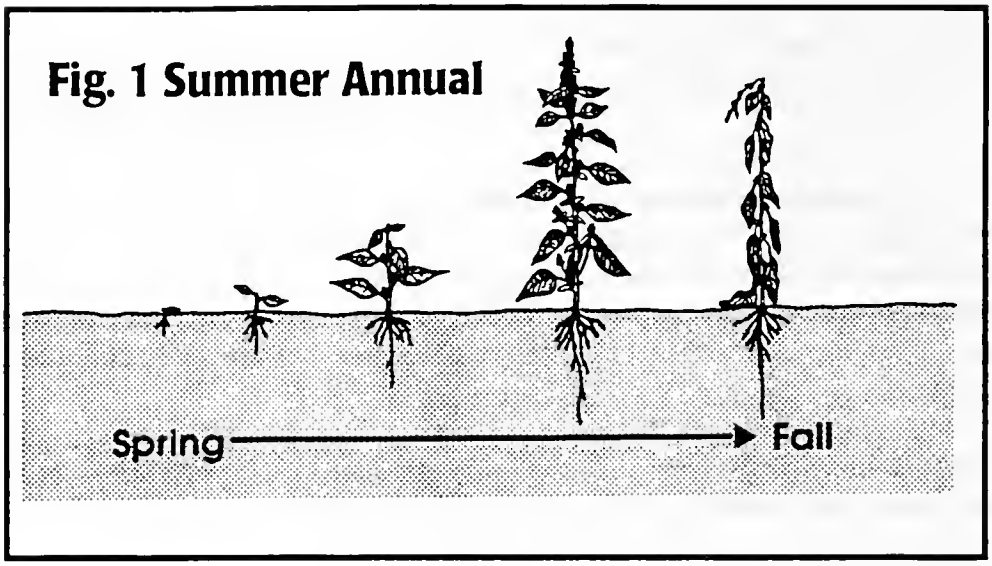
Biological control is the use of living organisms (insects, plant diseases, vertebrates) to control weeds. This is a long-term control method that suppresses rangeland weed populations and is generally not particularly effective in the school environment.

Herbicides can be effective tools in a weed management program. Many herbicides are selective for broadleaf or grassy weeds. Care must be taken when using herbicides in the school environment to avoid drift onto nontarget desirable vegetation.

An **integrated weed management** (IWM) program utilizes an effective combination of all the control and management techniques available in developing a longterm management plan for the control of weeds.

Classification Of Weeds

Weeds can be classified several different ways. Understanding the biology of the target weed is important when determining the correct method of control. In this manual, they are classified by their life cycle and their growth habits.

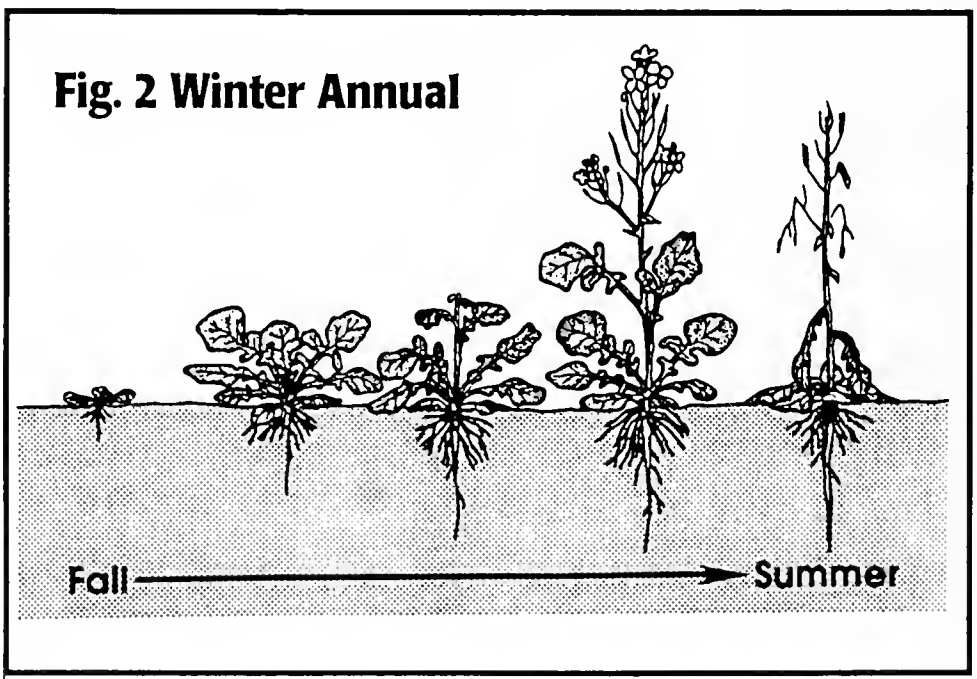


Life Cycle

Understanding the life cycle of the weed will help to determine at what point the plant is the weakest. Interruption at this point can provide effective control. All weeds are easier to control in the seedling stage.

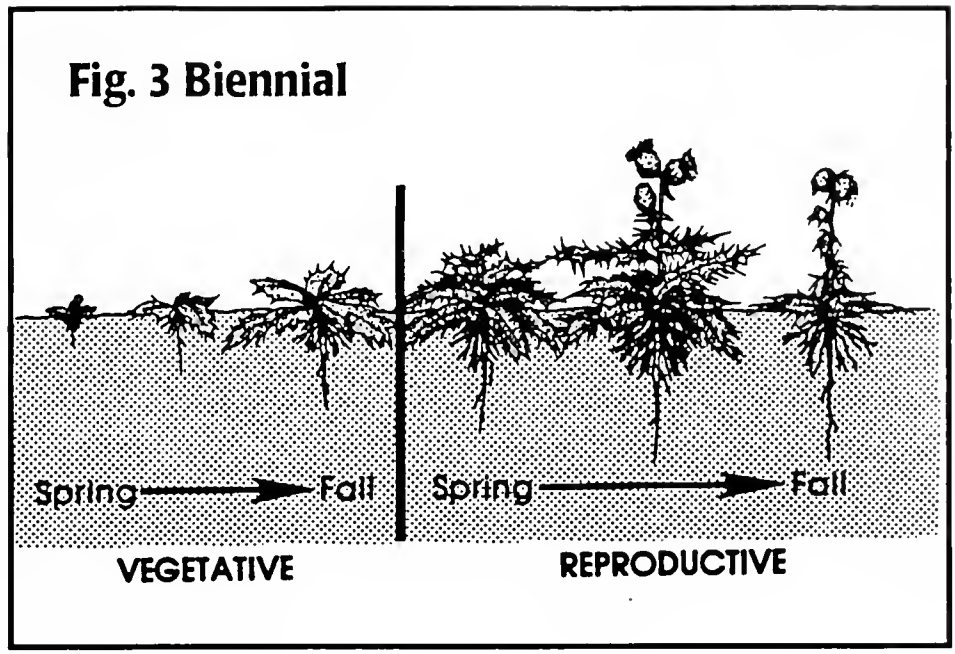
Annual weeds germinate from seed, flower, produce seeds and die in one year or less. Prevention of seed production is an effective control.

Annual weeds are further classified as summer or winter annuals. **Summer annuals** (Figure 1) germinate early in the growing season, grow and produce seed during the summer, mature and die by early to late fall. Lamb's-quarter, pigweed, ragweed, and foxtail are examples of summer annual weeds. **Winter annuals** (Figure 2) complete their life cycle from fall to spring or early summer. They germinate in the fall and overwinter as rosettes. They produce seed in very early spring and die by early to midsummer. Downy brome, field pennycress and tansy mustard are examples of troublesome winter annual weeds.



Biennial weeds (Figure 3) complete their life cycle in two years. During their first season of growth they develop a deep root system and a low growing rosette of leaves. They are dormant over the winter in the rosette

stage and send up flowering stalks early in the second spring of the life cycle. During the second year they flower, set seed, mature and die. Burdock, hound's-tongue and musk thistle are examples of common biennial weeds in Montana. Control is most effective during the first season of growth when the plant is in the rosette stage and prior to the development of viable seed.



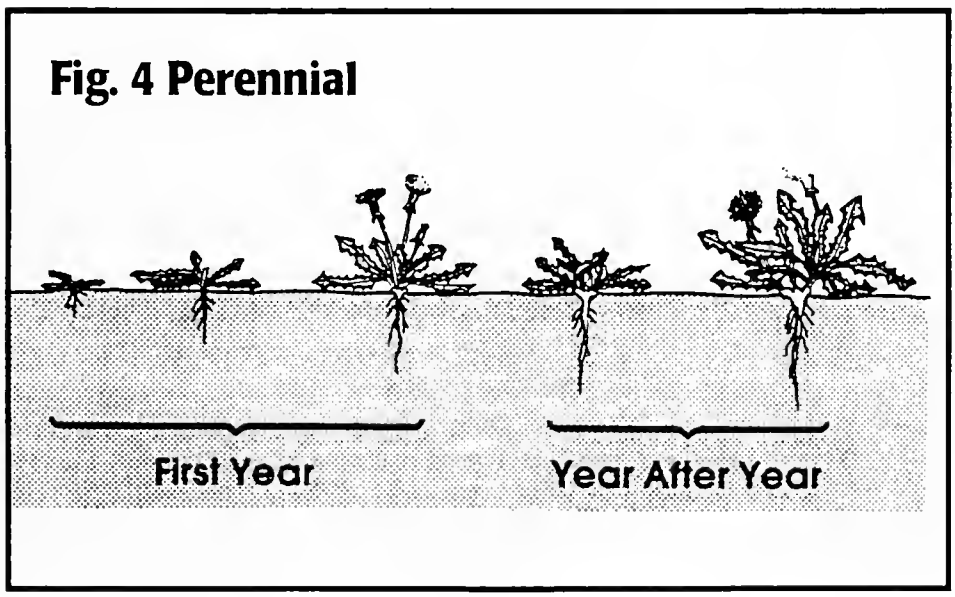
Perennial weeds live for more than two years. Most reproduce by seed and many are able to spread vegetatively by rhizomes,

tubers, or an extensive root system. They are classified according to their method of reproduction as simple or creeping.

Simple perennials spread by seed. Naturally, they do not spread vegetatively, but can produce new plants if injured or cut. The roots are generally fleshy and may grow very large. The plant regrows for many years from the crown area of the plant. Examples of simple perennials are dandelion, buckhorn plantain and spotted knapweed.

Creeping perennials reproduce by creeping roots, creeping above ground stems (stolons), or creeping below ground stems (rhizomes). Examples include field bindweed, Canada thistle, quackgrass and mouseear chickweed.

Some weeds propagate by means of tubers, which are modified rhizomes adapted for food storage. Nutsedge and Jerusalem artichoke are examples.



Once they infest an area, creeping perennials are probably the most difficult weed group to control. Plowing and tilling may only serve to spread the weed. Continuous and repeated cultivations, mowing and persistent herbicide applications are often necessary for effective control.

Plant Growth Habit

The plant growth habit—broadleaf, grass, or woody—is also important when choosing a control method.

Broadleaf plants have two seed leaves and generally have broad, net-veined leaves and tap roots or creeping roots. They have an exposed growing point at the top of the young plant and they have growing points in the leaf axils. For annual weeds, herbicides reach these areas readily and both herbicides and cultivation will control some of these plants effectively. Perennial broadleaf plants are more difficult to control because of numerous growing points on the creeping roots and stems. It is difficult for herbicides to reach these growing points and cultivation may break up the roots and spread them.

Grasses have one seed leaf with narrow, upright, parallel- veined leaves and a fibrous root system. A grass seedling has the growing point protected below the soil surface. Control is more difficult when the growing point is protected in this manner. Creeping perennials also have buds that are protected below the soil surface.

Woody plants include brush, shrubs and trees. Brush and shrubs are considered woody plants if they have several stems and are less than 10 feet tall. Trees usually have a single stem and are over 10 feet tall. Many woody plants, either cut or uncut, will sprout from the base or roots, making control more difficult.

Integrated Weed Management

A successful weed management program eliminates weeds without damaging desirable plants. The most effective program uses a combination of methods for weed control designed with site requirements and the biology of the target weed species to be controlled in mind. Good land and turf management practices should be the basis of any weed control program. Causes of weed problems should be identified and corrected. An integrated program for control may include: 1) prevention; 2) cultural and mechanical control; 3) biological control; and/or 4) chemical control.

Prevention is the most economical and practical method of controlling weeds. If weeds are not allowed to infest an area and produce seed, they will not become established. Preventive control methods that can be practical in the school setting may include: 1) use of clean (certified) seed; 2) use of clean implements and vehicles to prevent movement from an infested site to a non-infested site; 3) keep borders around the school weed free, including fence rows, roadsides, ditches and vacant lots; 4) do not bring infested plant materials into clean areas, making sure any new plantings are weed free, 5) use only clean mulch around ornamentals; and 6) spot treat small infestations or isolated individual plants to keep them from setting seed and spreading.

Cultural and mechanical control methods include mowing, hand pulling, hoeing, tillage, mulching, plant competition and plant rotation.

Mowing can be an effective weed control practice under certain conditions. Mowing may prevent seed production, deplete underground root reserves and favor the growth of more competitive plants, especially in a lawn situation. Mowing must be done prior to pollination to prevent seed production. Since most plants will regenerate, repeated mowing is required for adequate control. It is important to remember that repeated mowing may change an upright, single stemmed plant into a prostrate, several stemmed plant that can still set seed. Spotted knapweed is a good example of a plant that is not controlled effectively by mowing.

Hand pulling, hoeing and tillage can be a very effective control in many ornamental settings, especially for annual weeds. Cultivation stimulates the germination of weed seeds by bringing them to the soil surface. A second cultivation will easily kill new seedlings. Repeated tillage with meticulous follow-through may control some perennial weeds, such as Canada thistle, but may spread others, such as quackgrass and field bindweed, by moving rhizomes throughout the area.

Mulches control weeds by excluding light. They are most effective on annual weeds in small areas with high value plantings that are already established. Mulches are effective for weed suppression in many ornamental settings. Mulching materials should be thick enough to exclude light, easy to work with and relatively cheap. Straw, sawdust, wood chips, bark chips, grass, heavy plastic and paper clippings are all good mulches. Perennial weeds are not effectively controlled by mulches due to the persistent nature of their vegetative growth. Some excellent weed barrier fabrics are made to resist tearing but allow water and air to pass through them readily. Many perennial weeds are controlled with these weed mats. They are usually economically justified in plantings that will remain in place four years or more.

Plant competition encourages beneficial plants to compete more efficiently than weeds for sunlight, water, nutrients and space. In turf areas plant competition can be one of your most effective weed management strategies. Deep infrequent watering of turf areas, with water penetration to 6-8 inches will result in deep-rooted competitive turf. Allow the top inch of soil to dry out between waterings to kill weed seedlings and discourage lawn diseases. Raise mowing heights to 2-1/2 to 3 inches to develop stronger, more competitive grasses. These watering and mowing practices will eliminate most weeds in turf over time.

Early spring seeding can allow some plants to germinate and become established before the weeds. Planting larger, established ornamentals may also help to shade out annual weed seedlings.

Plant rotation is another weed control method that may be effective in some situations. Certain areas have their own characteristic weeds and repeated plantings of these plants will favor a build up of associated weeds, as well as insect and disease problems. Rotating plants also allows for rotation of weed control methods and herbicides. This may not be practical in many ornamental settings with long-term perennial plantings.

Biological control is the use of living organisms to control weeds. Insects are commonly used biological control agents, but nematodes, plant pathogens and vertebrates offer additional means of control in some settings. Biological control agents can be useful in the suppression of weeds, but do not contain weeds or stop their spread. Biological control seems to have most applicability in noncrop and rangeland sites and may be of limited application in the school environment.

Biological control agents are available for leafy spurge, with the flea beetle (*Aphthona spp.*) showing the most promise; spotted knapweed; and Dalmatian toadflax. Research continues on these weeds, with additional research being done on St. Johnswort (goatweed), sulfur cinquefoil, purple loosestrife, yellow toadflax and field bindweed.

Herbicides (chemical controls) are classified either by use (selective or nonselective) or mode of action (contact, translocated, or soil applied). Herbicides should be used as a supplement to good management practices and not as a replacement for them.

Use

Selective herbicides generally kill or retard the growth of one specific weed or class of weeds while not injuring other tolerant species. Many herbicides are selective for grasses or broadleaf plants. Selectivity may also be influenced by the age of the plant, growth rate, plant morphology and environment.

Nonselective herbicides are generally toxic to all plants without regard to species. Plants differ in susceptibility to any specific chemical and the choice of herbicide and application rate depends on the species to be controlled.

Mode of Action

Contact herbicides are foliage-applied and kill weeds by direct contact with plant parts. They are often referred to as plant "mowers" because only the plant area contacted is controlled. Good coverage is critical for effective control. Generally, contact herbicides are more effective on both perennial and annual seedlings and smaller, annual weeds. They are ineffective on established perennial weeds.

Translocated herbicides move throughout the entire plant system in the water stream (xylem), food stream (phloem), or both. They accumulate in and affect the active growth centers of the plant. Many translocated herbicides are also selective herbicides and are most effective when applied to the plant foliage.

Soil applied herbicides are often referred to as residual herbicides and are also translocated throughout the plant, generally in the xylem. They rarely are effective when applied to the foliage. The length of time soil applied herbicides remain active depends upon the chemical used, amount applied, rainfall, soil type and the plant species in the area.

The above classifications are generalizations. Compounds can be used selectively in some situations and nonselectively in others, depending on the rate and time of application.

A number of **precautions** should be observed when using herbicides in turf and landscape areas.

1. Read the manufacturer's label and accompanying material to determine the weeds it will control, the site it is registered for, how it should be used and other special precautions before selecting a herbicide for the area.

2. Make sure adequate moisture is available for effective weed control. For foliage applied herbicides, the weeds should be actively growing. Herbicides are less effective on plants that are water-stressed.

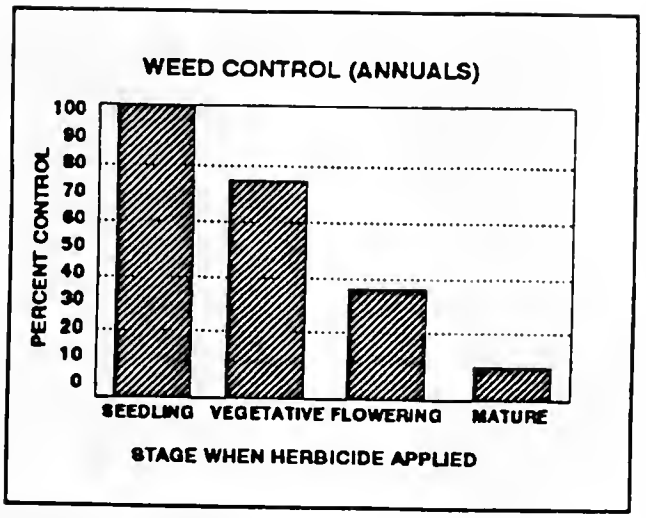
3. Most turf grass seedlings are sensitive to herbicide applications. Use care around new plantings. Often a preplant herbicide should be used to control weeds, with the turfgrass or ornamentals planted after the herbicide residue is gone.

4. Careful attention should be given to the use of herbicide-fertilizer mixtures. Specific requirements may be needed for both materials to be effective. Take care to avoid drift to nearby ornamentals or damage to roots.

5. Do not overtreat an area. Some herbicides take several days to several weeks to show symptoms.

Effective Timing Of Weed Control Methods

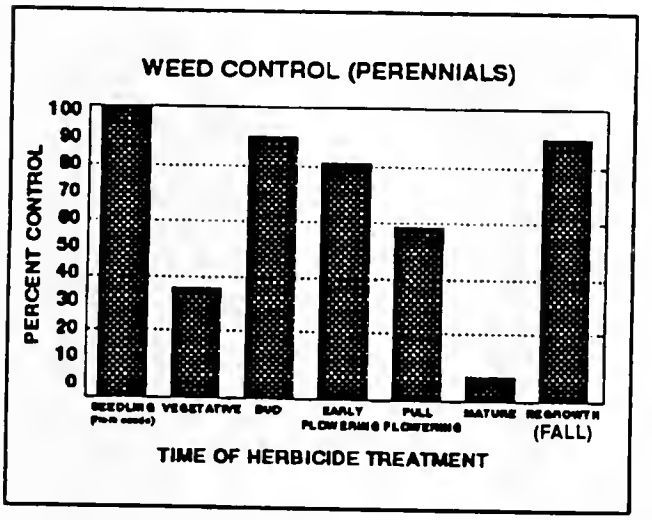
Annual weeds should be controlled before seed production starts. Control is most effective for all plants in the seedling stage. Weeds are small and succulent and less energy is required for control at this stage. Control, when the plant bolts (during the vegetative stage), is difficult because the plant is putting energy into the production of the stem and flower bud. Control



during the flowering stage of the plant will not stop seed production.

Biennial weeds should be controlled during the rosette stage in the first season or early in the second season before the plant begins to bolt.

Perennial weed control should target either the seedling stage, bud stage, or fall regrowth. Underground plant parts must be killed to control perennial weeds effectively. Fall treatment of the regrowth is often most effective because the plant is translocating nutrients to the root system and will effectively move the herbicide to the root.



Noxious Weeds And Legal Requirements

Under Montana's noxious weed law (MCA 7-22-2101 through 7-22-2153), it is unlawful to allow state or county designated noxious weeds to propagate or go to seed. The law is administered by local county weed districts. The state noxious weed list is set by rule of the Montana Department of Agriculture. Schools with noxious weeds on their property should contact their local weed district board to develop a long-term management plan that complies with the county plan.

The Montana noxious weed list includes Category 1, 2, and 3 weeds.

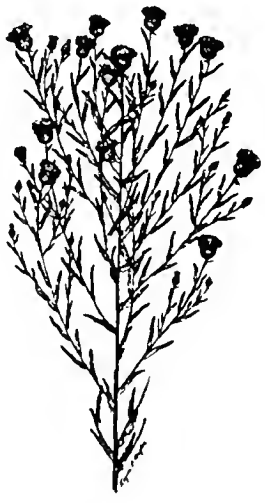
Category 1 noxious weeds are currently established and generally widespread in many counties of the state. Management criteria include awareness and education, containment and suppression of existing infestations and prevention of new infestations. These weeds are capable of rapid spread and render land unfit or greatly limit beneficial uses. They include: Canada Thistle (*Cirsium arvense*); Field Bindweed (*Convolvulus arvensis*); Whitetop or Hoary Cress (*Cardaria draba*); Leafy Spurge (*Euphorbia esula*); Russian Knapweed (*Centaurea repens*); Spotted Knapweed (*Centaurea maculosa*); Diffuse Knapweed (*Centaurea diffusa*); Dalmatian Toadflax (*Linaria dalmatica*); St. Johnswort (*Hypericum perforatum*); and Sulfur (Erect) Cinquefoil (*Potentilla recta*).

Canada thistle

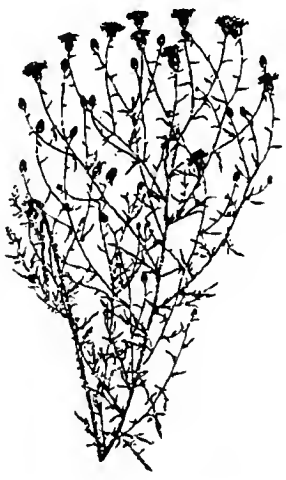
Field bindweed

Whitetop (hoary cress)

Leafy spurge



Russian knapweed



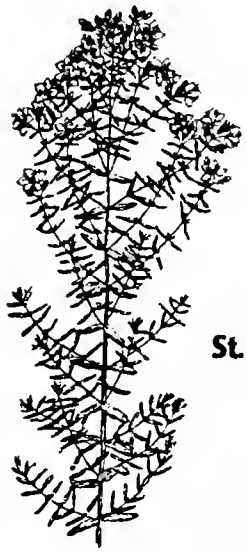
Spotted knapweed

Diffuse knapweed

Dalmation toadflax

Category 2 noxious weeds have recently been introduced into the state or are rapidly spreading from their current infestation sites. These weeds are capable of rapid spread and invasion of lands, rendering lands unfit for beneficial uses. Management criteria include awareness and education, monitoring and containment of known infestations and eradication where possible. They include: Dyers Woad (*Isatis tinctoria*) and Purple Loosestrife or Lythrum (*Lythrum salicaria, L. virgatum*, and any hybrid crosses thereof).

Category 3 noxious weeds have not been detected in the state or may be found only in small, scattered, localized infestations. Management criteria include awareness and education, early detection and immediate action to eradicate infestations. These weeds are known pests in nearby states and are capable of rapid spread and render land unfit for beneficial uses. They include: Yellow Starthistle (*Centaurea solstitialis*); Common Crupina (*Crupina vulgaris*); and Rush Skeletonweed (*Chondrilla juncea*).



St. Johnswort

Sulfur cinquefoil

Chapter Nine
Disinfectants

Disinfectants are used extensively in the school environment for sanitation and cleaning. Disinfectants are EPA registered pesticides because they make pesticidal claims for killing bacteria, molds, or viruses. These products are subject to the laws and regulations governing pesticides and their application.

Common disinfectant products used in the school are considered to be category IV pesticides. Thus, none of the signal words will appear on the label. However, most disinfectants, under certain conditions, are slightly toxic.

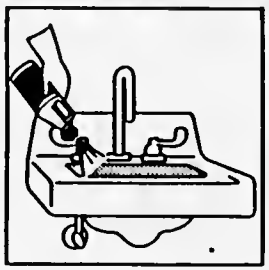
Disinfectants used by school personnel are very important for daily cleaning and maintaining sanitary conditions. Properly used, they fit well into a school IPM program. School personnel should be aware of the proper use of disinfectants. Material Safety Data Sheets (MSDS) should be kept on file for all disinfectants being used in the facility. Cleaning chemicals should be stored properly in the same manner as described for the other pesticides.

The first place to look for hazard information about disinfectants is on the manufacturer's container label. There are many different types of labels, but if the chemical is hazardous, the label will describe the conditions under which it should be used. Chemical manufacturers must determine the physical and health hazards of each product they manufacture and sell. School personnel should read labels on all disinfectant containers and carefully follow the instructions (Fig. 1 and 2).

When using disinfectants, all procedures involved in the use of hazardous pesticides should be followed to minimize risk to students, faculty and staff. Anyone using disinfectants should be instructed in the safe handling and use of disinfectant type chemicals before they are allowed to use them. The following guidelines should be used when handling disinfectants.

1. Carefully read the label before using a disinfectant. The MSDS sheet, available from the manufacturer, will provide special handling information.
2. Thoroughly wash with soap and water after handling disinfectants.
3. Keep disinfectants off hands, face and clothing.
4. Never smell, inhale, or taste disinfectants.
5. Smoking, drinking and eating should be prohibited in areas where disinfectants are being used.
6. Dispense only the amount of disinfectant to be used.
7. Always use disinfectants in a well ventilated area.
8. Use disinfectants only as directed and for their intended purpose.
9. Know the location of the nearest emergency shower and eyewash.

Sample label



SC Johnson Professional

CREW® NA

RTU

READY TO USE

14570

NON ACID BATHROOM CLEANER

•Virucidal

CLEANER • DISINFECTANT • DEODORANT

ACTIVE INGREDIENTS:

n-Alkyl (C_{14} 60%, C_{16} 30%, C_{12} 5%, C_{18} 5%) dimethyl benzyl ammonium chloride 0.09%

n-Alkyl (C_{12} 50%, C_{14} 30%, C_{16} 17%, C_{18} 3%) dimethyl ethylbenzyl ammonium chloride 0.09%

INERT INGREDIENTS: 99.82%

KEEP OUT OF REACH OF CHILDREN

CAUTION

NET CONTENTS 32 FL. OZ. (1 qt.) / 946 ml

CREW® NA RTU (Ready To Use)

Non Acid Bathroom Cleaner

Ready to use Germicide—Cleaner—Disinfectant—Deodorant

Not only helps control the hazard of cross-contamination from treated surfaces on hard, non-porous, environmental surfaces, but also kills many microorganisms that cause odors. Recommended for disinfecting hard, non-porous, inanimate surfaces for use in schools, colleges, and office buildings, and airports.

Kills Streptococcus pyogenes, Salmonella choleraesuis, Pseudomonas aeruginosa, Staphylococcus aureus, A. Trichophyton interdigitale (Athlete's Foot Fungus). *Virucidal against influenza type A, Herpes Simplex type 2, and HIV-1 (AIDS virus).

DIRECTIONS FOR USE

It is a violation of Federal Law to use this product in a manner inconsistent with its labeling.

FOR DISINFECTING: Apply by mop, sponge, or cloth to hard non-porous surfaces for a minimum contact time of ten minutes in a single application. For disinfecting, remove gross food particles and heavy soil deposits, then thoroughly wet surfaces. Ready to use solution may be used once and discarded. Rinsing is not necessary on floor surfaces which are to be waxed or polished.

BATHROOM: Great for cleaning and deodorizing basins, tubs, and tiles. Leaves everything bright and clean, kills odor-causing household germs. Odors disappear instantly. Use where odors are a problem.

TO CLEAN AND DISINFECT TOILET BOWLS: Remove or expel over the inner trap residual bowl water prior to applying use solution. Use 4 ounces of concentrate in toilet bowl. Squeeze around bowl and under rim. Then scrub thoroughly with brush. This product, when used as directed, will not harm white or colored bowls or inanimate, hard surfaces. Close cap on container after use. For urinals add 4 ounces of concentrate. Then scrub thoroughly with a brush for a contact time of ten minutes.

MILDEWSTATIC INSTRUCTIONS: Will effectively inhibit the growth of mold and mildew plus the odors caused by them when applied to hard, non-porous surfaces such as walls, floors, and table tops. Apply solution making sure to wet all surfaces completely. Let air dry. Repeat application weekly or when growth reappears.

*Kills HIV-1 (AIDS virus) on precleaned environmental surfaces/objects previously soiled with blood/body fluids in healthcare settings or other settings in which there is an expected likelihood of soiling of inanimate surfaces/objects with blood or body fluids, and in which the surfaces/objects likely to be soiled with blood or body fluids can be associated with the potential for transmission of human immunodeficiency virus Type 1 (HIV-1) (associated with AIDS).

SPECIAL INSTRUCTIONS FOR CLEANING AND DECONTAMINATION AGAINST HIV-1 (AIDS VIRUS) OF SURFACES/OBJECTS SOILED WITH BLOOD/BODY FLUIDS

Personal Protection: Disposable latex or vinyl gloves, gowns, face masks, or eye coverings as appropriate, must be worn during all cleaning of body fluids, blood and decontamination procedures.

Cleaning Procedures: Blood and body fluids must be thoroughly cleaned from surfaces and objects before application of disinfectant.

Contact Time: Effective against HIV-1 (AIDS virus) on hard non-porous surfaces in the presence of a moderate amount of organic soil (5% blood serum) (providing 1800 ppm of active quaternary) for a contact time of 5 minutes at room temperature (20-25°C). Use a ten (10) minute contact time for disinfection against all other bacteria, fungi, and viruses claimed (listed on labeling).

Disposal of Infectious Materials: Blood and other body fluids should be autoclaved and disposed of according to federal, state, and local regulations for infectious waste disposal.

CONTAINER DISPOSAL: Do not reuse empty container. Rinse thoroughly before discarding in trash. Securely wrap original container in several layers of newspaper and discard in trash.

GENERAL: Consult federal, state, or local disposal authorities for approved alternative procedures, such as limited open burning.

Questions: Call 800-558-2332 Weekdays 8-5 Central Time

EPA Reg. No. 47371-97-4822 EPA Est. No. 0312-WI-1

407586 (95/137)

S.C. Johnson Wax
Racine, Wisconsin 53403-5011
Phone:(414) 631-2777
Emergency Phone:(800) 228-5635

4=Very High
3=High
2=Moderate
1=Slight
0=Insignificant

HAZARD RATING

HMIS		NFPA
1	Health	
0	Flammability	
0	Reactivity	

MATERIAL SAFETY DATA SHEET

SECTION I-PRODUCT IDENTIFICATION

PRODUCT NAME:			PRODUCT CODE:
CREW NA			14570-3 to 14574-3
CHEMICAL OR COMMON NAME:	DATE ISSUED:	SUPERSEDES:	PREPARED BY:
NA	10/18/91	05/07/91	Terry A. Meyers Chemical Info. Adm.

SECTION II-INGREDIENT INFORMATION

INGREDIENTS	WEIGHT %	EXPOSURE LIMIT
Quaternary Ammonium Compound (CAS# NA)	< 0.5	None
Water (CAS# 7732-18-5)	95.5-99.5	NA
See Regulatory Information (Section XII) for explanation of bracketed information.		

SECTION III-PHYSICAL DATA

APPEARANCE/ODOR: Blue With Liquid Floral Odor	SPECIFIC GRAVITY (H20=1): 1.01
VAPOR PRESSURE (mm Hg): Same as water	PERCENT VOLATILE BY VOLUME (%): NA
SOLUBILITY IN WATER: Complete	VAPOR DENSITY (Air=1): Same as water
FREEZING POINT (°F): about 32	BOILING POINT (°F): above 200
pH: 10..5-12.0	EVAPORATION RATE (Butyl Acetate=1): NA
VOC (as packaged, minus H2O): ND	THEORETICAL VOC (lb/gal): ND

SECTION IV-FIRE AND EXPLOSION INFORMATION

FLASH POINT (°F) (Method Used):	NA
FLAMMABLE LIMITS:	NA
EXTINGUISHING MEDIA:	Foam. CO2. Dry Chemical. Water Fog.
SPECIAL FIREFIGHTING PROCEDURES:	Normal fire fighting procedures may be used.
UNUSUAL FIRE AND EXPLOSION HAZARDS:	No special hazards known.

SECTION V-HEALTH HAZARD DATA

PRIMARY ROUTE OF ENTRY:	Eye contact.
SIGNS AND SYMPTOMS:	Direct contact of product with eyes may cause minor irritation. Prolonged or repeated contact of undiluted product with skin may cause minor irritation.
FIRST AID PROCEDURES:	Flush eyes with water for 15 minutes. If irritation persists, seek medical aid. If product gets on skin, remove with soap and water. If product is swallowed, drink large amounts of water or milk and seek medical aid.

S.C. Johnson Wax
1525 Howe Street
Racine,Wisconsin 53403

CREW NA
Product Number: 14570
Serial Number: 3

SECTION V-HEALTH HAZARD DATA (cont.)

MEDICAL CONDITIONS GENERALLY RECOGNIZED AS BEING AGGRAVATED BY EXPOSURE:

SECTION VI-REACTIVITY DATA

STABILITY: Stable

STABILITY-CONDITIONS TO AVOID: None known

INCOMPATIBILITY: Strong acids (e.g., muriatic acid).

HAZARDOUS DECOMPOSITION PRODUCTS: When exposed to fire, produces normal products of combustion.

HAZARDOUS POLYMERIZATION: Will not occur.

HAZARDOUS POLYMERIZATION-CONDITIONS TO AVOID: None known

SECTION VII-SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED: Absorb with oil-dri or similar inert material. Sweep or scrape up and containerize. Rinse affected area thoroughly with water.

WASTE DISPOSAL INFORMATION: No special method. Observe all applicable Federal/State regulations and Local ordinances regarding disposal of non-hazardous materials. Waste from normal product use may be sewered to a public-owned treatment works (POTW) in compliance with applicable Federal, State, and local pretreatment requirements.

SECTION VIII-SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION: No special requirements under normal use conditions.

VENTILATION: General room ventilation adequate.

PROTECTIVE GLOVES: If prolonged or repeated contact is possible: Any impervious material.

EYE PROTECTION: Eye protection not required unless contact with undiluted product is possible.

OTHER PROTECTIVE MEASURES: Use good personal hygiene practices. Where gross eye/skin contact may be a problem, wear/use appropriate protective equipment.

SECTION IX-SPECIAL PRECAUTIONS

PRECAUTIONARY LABELING: CAUTION: Avoid contact with eyes. If such contact occurs, flush immediately with water for 15 minutes. If irritaion persists, see a doctor.

OTHER HANDLING AND STORAGE CONDITIONS: Wash thoroughly after handling. Keep out of reach of children.

SECTION X-ADDITIONAL INFORMATION

ADDITIONAL INFORMATION: EPA Registration No.: 47371-97-4822

SECTION XI-TRANSPORTATION INFORMATION

DOT CLASS: Non Regulated.

DOT #: NA

SHIPPING NAME: NA

DOT NOTES: None

SECTION XII-REGULATORY INFORMATION

There are no ingredients subject to the reporting requirements under California's Proposition 65.

NA-Not Applicable, NE-Not Established, NSS-No Special Requirement, ND-Not Determined for this product

Glossary

Ametabolous: Having no metamorphosis. Adults are primitive and wingless (i.e., silverfish).

Annual: A plant that completes its entire life cycle in one year or in one growing season.

Biennial: A plant that requires two years or two growing seasons to complete its life cycle.

Biological Control: The control of pests by employing predators, parasites or diseases that are encouraged and disseminated by man.

Cornicles: Tubular structures on each side of the upper posteror end of the abdomen of aphids from which various alarm pheromona are expelled.

Exoskelton: A supporting structure on the outside of the body of insects composed of chitin.

Fungicide: Chemicals used to control fungi.

Gregarious: A tendency to live in groups (e.g., tent caterpillar).

Haltere: Short-knobbed appendages present in place of the hind wings of true flies. They are sense organs that help in balance during flight.

Herbicide: Chemicals used to kill plants, usually weeds. Commonly called weed killers.

Hemi-metabolous: Type of incomplete or gradual metamorphosis where the immatures are aquatic and referred to as naiads.

Holome-tabolous: Complete metamorphosis; egg, larva, pupa and adult.

Insect: A member of the class *Insecta,* six-legged.

Insecticide: A chemical used to kill and control insects.

Instar: The stage between molts.

Larva: The immature insect hatching from the egg and up to the pupal stage in Orders with complex or holomotabolous metamorphosis.

Mandible: One of a pair of "jaws" of an insect, normally used for chewing.

Metamorphosis: The transformation or change in form during the development of an insect.

Molt: The process of shedding the skin.

Ootheca: An egg case formed by the secretions of the accessory genital glands or oviducts, as in cockroches.

Ovipositor: An egg-laying organ at the rear end of the female's abdomen.

Pathogen: Any organism that is capable of causing disease.

Pedicel: A protrusion on the basal stalk of the abdomen of ants. A useful indentification characteristic to distinguish from termites, etc.

Perennial: A plant that survives more than two years and often indefinitely. Perennial plants usually produce seeds each year; they then may become dormant before starting new vegetative growth or repeating the cycle.

Petiole: Another name for pedicel (in insect anatomy).

Phloem: Tissue in the vascular system of higher plants that conducts foods (sugars, proteins, minerals).

Pheromone: A chemical substance, usually a glandular secretion, which is used in communication within a species.

Proleg: The soft fleshy, unjointed leg-like structures, usually paired, that provide support or attachment and are characteristic of caterpillars.

Pronotum: The under surface of the prothorax.

Prothorax: The first segment of the thorax, which bears the head and the first pair of legs, if present.

Summer Annual: A plant that germinates in the spring, grows, sets seed and dies before fall.

Systemic: A term applied to a substance that spreads throughout the entire body or plant, including roots.

Weed: A plant out of place. Its location makes it more harmful than beneficial.

Winter Annual: A plant that germinates in the fall, overwinters, matures, sets seed and dies in the spring or early summer.

Vector: Any carrier of a disease producing organism.

Viviparous: Giving birth to live young that have developed with no identifiable egg stage.

Xylem: A complex tissue in the vascular system of higher plant that conducts water and mineral salts taken in by the roots.

Resources

The references and materials listed in this section have been reviewed in preparation of this manual. A perusal of these publications and visual material will provide additional information that will be helpful in carrying out a school IPM program.

Insects

Identification

Pests of Landscape Trees and Shrubs, S.H. Dreistade, University of California, Pub. 3359, 1994.

Common-Sense Pest Control, W. Olkowski, S. Daar, H. Olkowski, 1992. Taunton Press.

The Audubon Society Field Guide to North American Insects and Spiders, L. Milne, Alfred A. Knopf Inc. Pub., 1993.

Management

Pests of Landscape Trees and Shrubs, S.H. Dreistade, University of California, Pub. 3359, 1994.

Structural (PCO) and Health Related Training Manual, Montana Department of Agriculture, 1992.

Common-Sense Pest Control, W. Olkowski, S. Daar, H. Olkowski, 1992. Taunton Press.

Household Insects of the Rocky Mountain States, Colorado State University Bulletin 557A, 1994.

Complete Guide to Pest Control, With and Without Chemicals. G. Ware. 1988, 2nd Ed. Thompson Pubs. Fresno, CA 93791.

Vertebrates

Prevention and Control of Wildlife Damage, Hygnstrom, S.E., R.E. Timm and G. E. Larson, Eds., Great Plains Agricultural Council-Wildlife Committee., University of Nebraska Cooperative Extension, Lincoln, NE, 1994.

Complete Guide to Pest Control, With and Without Chemicals. G. Ware. 1988, 2nd Ed. Thompson Pubs. Fresno, CA 93791.

Montana Department of Agriculture Bulletins, Montana Department of Agriculture, Box 200201, Helena, MT (406) 444-5400

- *Biology and Control of the Columbian Ground Squirrel*
- *Biology and Control of the Richardson Ground Squirrel*
- *Prairie Dog Control*
- *Pocket Gopher Control Techniques*
- *Managing Ground Squirrels with Bait Stations*
- *Controlling Burrowing Rodents with Burrow Fumigants*
- *Using Zinc Phosphide Effectively*
- *Rozol Ground Squirrel Bair - Proper Use Practices*
- *Registered Field Rodenticide (updated as needed)*
- *Skunk Management*
- *House Bat Management*

Montana Department of Agriculture Videos, Montana Department of Agriculture, Box 200201, Helena, MT (406) 444-5400

- Managing Prairie Dogs in Montana, 1992.
- Biology and Control of the Richardson Ground Squirrel in Montana, 1995.

- Biology and Control of the Columbian Ground Squirrel in Montana, 1995.
- Pocket Gopher Control in the Yard and Garden, 1995.

Miscellaneous Resource Materials

Information on minor or occasional vertebrate pests including birds, voles, porcupines and other wildlife species is available. This material is not available for general distribution but is supplied by the Montana Department of Agriculture on request and in response to specific problems.

Weeds

Identification

Weeds of the West, Tom D. Whitson, Editor, Western Society of Weed Science, January, 1991.

Weeds of Eastern Washington & Adjacent Areas, Xerpha M. Gaines and D.G. Swan, Camp-Na-Bor-Lee Association, Inc., 1972.

Weeds of Nebraska and the Great Plains, James tubbendieck, Geir Y. Friisoe, and Margaret R. Bolick, Nebraska Department of Agriculture, 1994.

Management

Pests of Landscape Trees and Shrubs, S.H. Dreistade, University of California, Pub. 3359, 1994.

Common-Sense Pest Control, W. Olkowski, S. Daar, H. Olkowski, 1992. Taunton Press.

Herbicide Handbook, Seventh Edition, William H. Ahrens, Editor, Weed Science Society of America, 1994.

Methods of Applying Herbicides, C.G. McWhorter & M.R. Gebhardt, Editors, Monograph No. 4, Weed Science Society of America, 1987.

Weeds of the United States and their Control, Harri J. Lorenzi and Larry S. Jeffery, Van Nostrand Reinhold Co., 1987.

General Information

Basic Pesticide Training Manual, Montana Department of Agriculture, Environmental Management Division, Helena, MT., 1990.

Common-Sense Pest Control, W. Olkowski, S. Daar, H. Olkowski, 1992. Taunton Press.

Fundamentals of Pesticide Use and Application, Andrew Martin and Arlene Blessing, Purdue University Cooperative Extension Service, West Lafayette, Indiana, 1995.

Chemical-Free Yard and Garden. 1991. Rodale Press, Emmaus, PA 18098.

The Montana Model School Integrated Pest and Pesticide Management Program, Montana Department of Agriculture, Helena, MT., 1994.

Insects and Human Society, T. Michael Peters, University of Massachusetts, Belchertown, MA., 1993.